FEDERAL SOFTWARE AND RELATED SERVICES

1989 - 1994

INPUT

About INPUT

INPUT provides planning information, analysis, and recommendations for the information technology industries. Through market research, technology forecasting, and competitive analysis, INPUT supports client management in making informed decisions.

Subscription services, proprietary research/consulting, merger/acquisition assistance, and multiclient studies are provided to users and vendors of information systems and services. INPUT specializes in the software and services industry which includes software products, systems operations, processing services, network services, systems integration, professional services, turnkey systems, and customer services. Particular areas of expertise include CASE analysis, information systems planning, and outsourcing.

Many of INPUT's professional staff members have more than 20 years' experience in their areas of specialization. Most have held senior management positions in operations, marketing, or planning. This expertise enables INPUT to supply practical solutions to complex business problems.

Formed as a privately held corporation in 1974, INPUT has become a leading international research and consulting firm. Clients include more than 100 of the world's largest and most technically advanced companies.

INPUT OFFICES

North America

San Francisco
1280 Villa Street
Mountain View, CA 94041-1194
Tel. (415) 961-3300   Fax (415) 961-3966

New York
Atrium at Glenpointe
400 Frank W. Burr Blvd.
Teaneck, NJ 07666
Tel. (201) 801-0050   Fax (201) 801-0441

Washington, D.C.
INPUT, INC.
1953 Gallows Road, Suite 560
Vienna, VA 22182
Tel. (703) 847-6870   Fax (703) 847-6872

International

London
INPUT LTD.
Piccadilly House
33/37 Regent Street
London SW1Y 4NF, England
Tel. (071) 493-9335 Fax (071) 629-0179

Paris
INPUT SARL
24, avenue du Recteur Poincaré
75016 Paris, France
Tel. (33-1) 46 47 65 65 Fax (33-1) 46 47 69 50

Frankfurt
INPUT LTD.
Sudetenstrasse 9
D-6306 Langgöns-Niederkleen, Germany
Tel. (0) 6447-7229 Fax (0) 6447-7327

Tokyo
INPUT KK
Saida Building, 4-6
Kanda Sakuma-cho, Chiyoda-ku
Tokyo 101, Japan
Tel. (03) 3864-0531 Fax (03) 3864-4114

DECEMBER 1989

FEDERAL SOFTWARE AND RELATED SERVICES

1989-1994

INPUT®

1953 Gallows Road, Suite 560, Vienna, VA 22182   (703) 847-6870

Published by
INPUT INC.
1953 Gallows Road, Suite 560
Vienna, VA 22182
U.S.A.

Federal Information Systems and Services
Program (FISSP)

*Federal Software and Related Services,
1989-1994*

GSR3 • 416/437 • 1989

Abstract

INPUT expects the federal government market demand for software and related services to increase from $1.97 billion in 1989 to $3.38 billion in 1994. The market will experience overall sustained growth at a compound annual growth rate of 11% throughout the period.

Federal Software and Related Services, 1989-1994 consists of two distinct but interrelated segments: packaged software (both systems and applications) and their maintenance and professional services activities associated with custom software development of systems and applications. During the period of interest of this report the software products market will grow more rapidly, but software development will continue to account for the majority of federal expenditures for software.

This report focuses on agency buying patterns, technical and other factors that influence agency procurement practices, and vendor marketing strategies. Major federal software opportunities are also included to help vendors assess their marketing strategies through 1994.

This report contains 185 pages, including 73 exhibits.

Table of Contents

Table of Contents (Continued)

Table of Contents (Continued)

Exhibits

Exhibits (Continued)

IV

Exhibits (Continued)

Exhibits (Continued)

Introduction

Federal Software and Related Services, 1989-1994 is a revision of an earlier report issued in 1987. The report has been revised in response to continuing client interest in this segment of the federal market. The report builds on the previous INPUT market analysis with extensive revisions to reflect government fiscal year 1990 agency budgets, opportunities at agencies, and insight into the factors impacting this market. This report offers guidance to vendors in planning their strategies to compete for federal software products and services.

This report was prepared as part of INPUT's Federal Information Systems and Services Program (FISSP). Reports issued through this program are designed to assist INPUT's U.S. industrial clients in planning how to satisfy future federal government needs for computer-based information systems and services. The report's findings are based on research and analyses of several sources, including:

- INPUT's Procurement Analysis Reports (PARs)

- OMB/GSA/NIST Five-Year Information Technology Plans for 1990-1995

- Interviews with leading software contractors

- Interviews with federal agency officials who manage existing software contracts

- Federal agency GFY 1989 and GFY 1990 Information Technology Budgets

A

Scope

The period covered in the report is GFY 1989 through 1994. Vendor interviewees were selected because they were identified either as contractors of record for existing software contracts or listed as software providers in INPUT's Vendor Analysis and Planning Service data base for 1989.

For the purposes of this study, INPUT defined software and related services to encompass the following categories of products and services (see Appendix B for detailed explanations of each category):

• Packaged systems software
• Packaged applications software
• Custom systems software
• Custom applications software
• Contract software maintenance

Exhibit B-2 in Appendix B provides a detailed schematic of the types of products and relationships between products covered in this report.

Expenditures for purchase, lease or rental, and maintenance are counted as software products expenditures.

Software development, sometimes called contract programming or programming and analysis, is a subset of professional services.

B

Methodology

The OMB/GSA/NIST Five-Year Plan analysis for the INPUT *Procurement Analysis Report* was reviewed for programs to be initiated during the GFY 1989-1994 period. INPUT also researched agency long-range plans for GFY 1990-1994 to identify significant budget changes and leading and tagging agencies for software opportunities.

The questionnaires developed for agency officials and vendors are included in Appendix F.

Agency questionnaires were designed to acquire information about current experience and plans for future use of software products and services.

The vendor questionnaire was designed to acquire information on industry market penetration, and future federal software market plans.

Federal agency officials selected for interview included:

• Program managers
• Policy officials

Industry representatives selected for interview included:

- Marketing executives
- Technical executives
- Corporate executives

Current versions of the Federal Information Resource Management Regulations, Federal Acquisition Regulations, Defense Acquisition Regulations (changes to FAR), and the Multiple Agreement Schedule policy were investigated to identify changes that will impact software procurements. OMB Federal Contract Reporting Center data for GFY 1988 were reviewed to identify contract vendor marketshares. GSA and the Ada Joint Program Office sources also were utilized to identify software trends and opportunities.

C

Report Organization

This report consists of five additional chapters:

- Chapter II is an Executive Overview describing the major points and findings in the report.

- Chapter III provides the market forecast and describes the major market issues and trends impacting the industry.

- Chapter IV summarizes federal agencies' requirements for software and related services.

- Chapter V presents the vendors' perspectives on the federal software market.

- Chapter VI provides a sample of software opportunities presented by programs and initiatives in the federal market.

Several appendixes are also provided:

- Interview Profiles
- Definitions
- Glossary of Federal Acronyms
- Policies, Regulations, and Standards
- Related INPUT Reports
- Questionnaires

Following the appendixes is a description of INPUT and its programs and services.

![II]
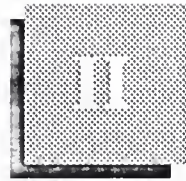
Executive Overview

A
Federal Market Pressures

The federal market for software products and related services is expected to experience continued growth over the next few years. Some of the pressures contributing to this growth are listed in Exhibit II-1. Government information systems require steady improvement in terms of the quality and effectiveness of overall software support.

EXHIBIT II-1

Federal Market Pressures

- Technical staff shortages
- Productivity improvement
- Budget deficit

Agencies continue to place a strong emphasis on maintenance and enhancement of existing software systems, as well as to develop new software systems as advances in technology become available. However, staff shortages effectively prevent in-house performance of these software support tasks. Agencies continue to have difficulty in competing with the commercial market for strong technically qualified personnel. Many federal employees with less than 15 years of service are leaving the government. Agencies are increasingly forced to contract out most of their software development and support activities.

The Reagan administration encouraged contracting out of many formerly in-house activities, especially software development and maintenance functions. The growing emphasis on OMB Circular A-76, as well as Executive Order 12615 ("Performance of Commercial Activities") illustrates the government policy toward contracting out. To achieve productivity goals and take advantage of technology, agencies are encouraged to increasingly look to contractor services for assistance.

The continuing federal budget deficit places increased constraints on agencies while they strive to improve productivity of their information systems. In some cases deficit control measures are decreasing planned improvements to systems, while in other cases it is forcing reliance on technology improvements.

B

Market Segments

INPUT's updated forecast and analysis focuses on several specific types of commercially acquired software products and services by the federal government.

- Software products, sometimes called software packages, include off-the-shelf applications and systems software products and their maintenance.

- Software development services, also called programming and analysis can be applied to the modification of applications and systems software, and include custom software development. Maintenance for customized software is also associated with software development services.

INPUT has divided the software products market segments into systems or applications software, as shown in Exhibit II-2. The forecast for these segments includes expenditures based on purchase, lease, or rental of software products.

EXHIBIT II-2

Federal Software and Related Services Market Structure

Means of Acquisition • Type of Acquisition	Type of Software	
	Applications	Systems
Software Products Packages		
• Purchase	X	X
• Lease/Rental	X	X
Maintenance		
• Purchase	X	X
Professional Services		
• Customize Off-the-Shelf Package Purchase	X	X
• Custom Development Purchase	X	X

C

Market Forecast

INPUT estimates that the federal government software and related services market will increase from $1.97 billion in GFY 1989 to $3.38 billion in GFY 1994, with an overall CAGR of 11%, as shown in Exhibit II-3. This estimate is similiar to forecasts of expenditures and CAGRs presented in the prior edition.

The software products market will grow at a much higher CAGR (17%) than software development. The software products forecast has risen slightly from the 15% CAGR that INPUT previously forecasted two years ago.

EXHIBIT II-3

Federal Software Market, GFY 1989-1994

D
_____
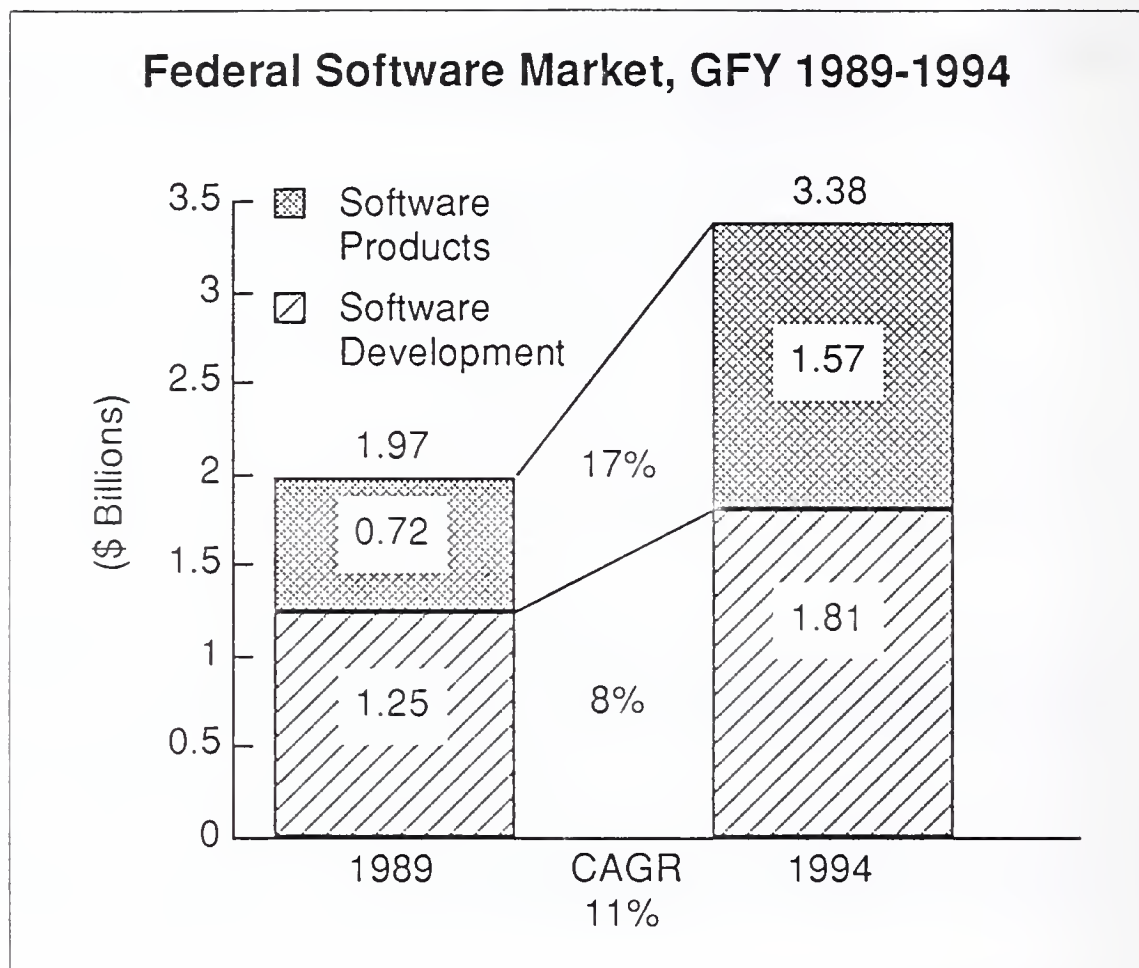
| Leading Agency | Federal agencies fund software and related services acquisitions through |
| Buyers | portions of several Information Technology Budget categories. |

- Capital Investments

- Operating Costs
  - Lease/rental
  - Supplies

- Commercial Services
  - Systems analysis and programming

During GFY 1989, five agencies—Air Force, NASA, Army, Energy, and Navy—spent three-fourths of the reported software and related services outlays, as shown in Exhibit II-4. The data verify that software development outlays continue to consume the major portion of federal expenditures for software.

None of the remaining agencies requested a significant portion of the Information Technology Budget, but their collective total was approximately 25% of the line items for this budget category.

EXHIBIT II-4

Largest Agency Buyers of Software and Related Services, 1989

Energy 12%

Air Force 21%

Navy 11%

Army 13%

NASA 19%

Other 24%

◿ Software Products

☐ Software Development
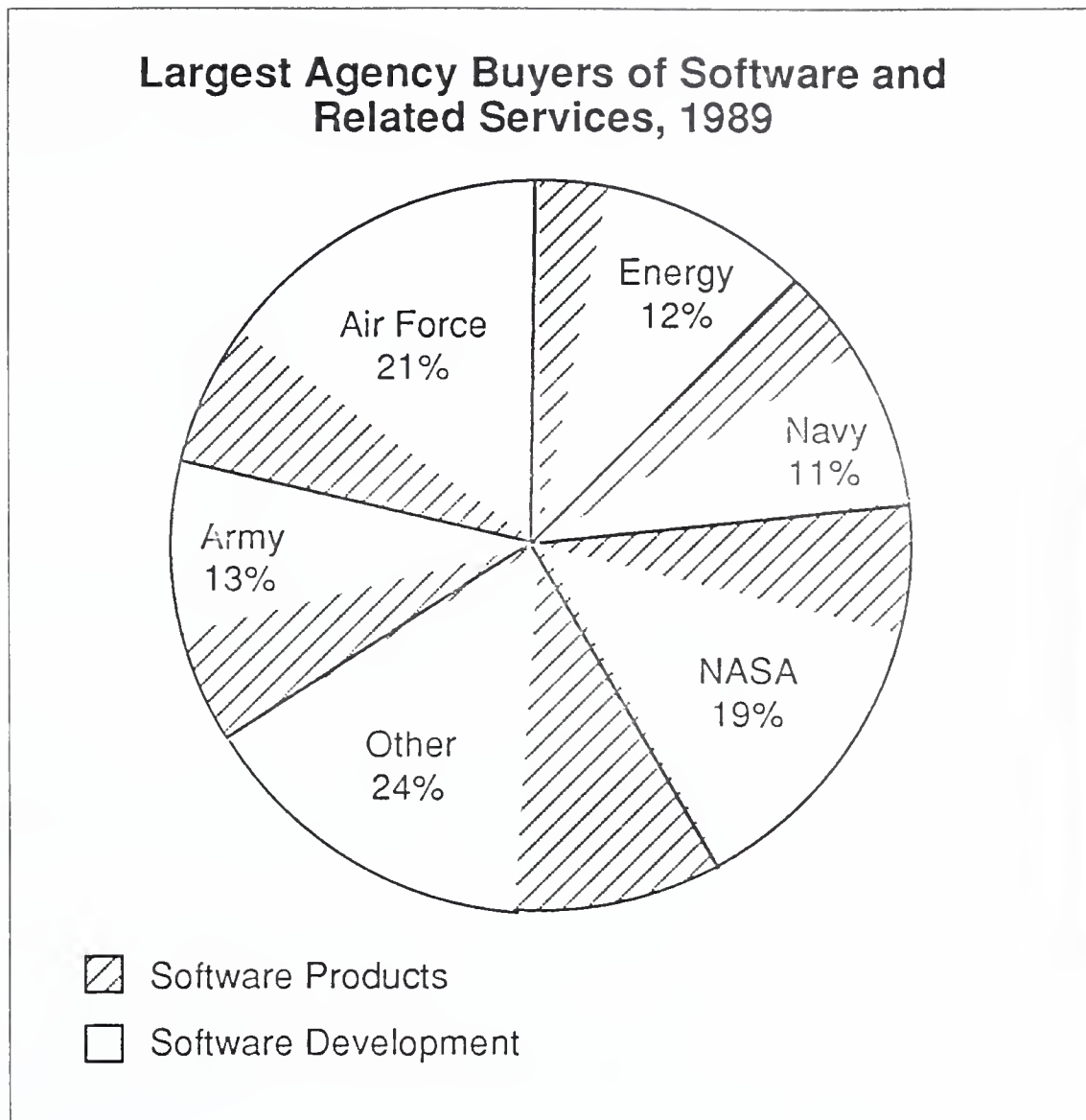
E

Selection Criteria

Federal agencies place more importance on relevant experience when evaluating vendors for software development efforts, as shown in Exhibit II-5.

Vendor experience with similar development and integration efforts, the applications to be developed, and the languages to be used outweigh other factors such as price, agency experience, or even federal experience.

Both civil and defense agencies rated these experience factors as most important. The ratings of other selection criteria differed only slightly between civil and defense agencies.

Education and training capabilities also are closely scrutinized by buying agencies. These agencies seek assurance that not only will the vendor be

Software Development Vendor Selection Criteria

- Experience
- Development
- Application
- Target language
- Integration
- Training

able to develop the system, but also will provide the postimplementation support required to operate and manage the systems via in-house personnel.

Federal agency buyers tend to focus on product characteristics rather than vendor reputation and experience in the selection of packaged software products (see Exhibit II-6). Product commitment, ease of use, performance, documentation, and training consistently rate as the most important selection criteria for both systems and applications packaged software products. Product commitment is a special concern for buyers who must plan for relatively long system lives. Products that are not supported and enhanced over time may be viewed as unacceptable risks as a by-product and be eventually replaced and incur conversion costs.

Agency Software Product Selection Criteria

- Product commitment
- Ease of use
- Documentation
- Training

On the other hand, documentation and training are important product characteristics in view of the change and variety of users over the expected lifetime of the product. Agency respondents reported that price and federal experience are usually given less weight in the selection process.

F
Leading Vendors

The federal government acquires software and related services from a broad range of vendors including hardware manufacturers, systems integrators, professional services firms, and software product developers. Exhibit II-7 shows the leading vendors for GFY 1988 based on the Federal Contracts Award data base.

EXHIBIT II-7

Leading Software and Related Services Vendors, GFY 1988

IBM 9%
EDS 6%
Unisys 5%
CSC 4%
Data Processing Resources 4%
Other 72%

1988 total user expenditures = $790 million
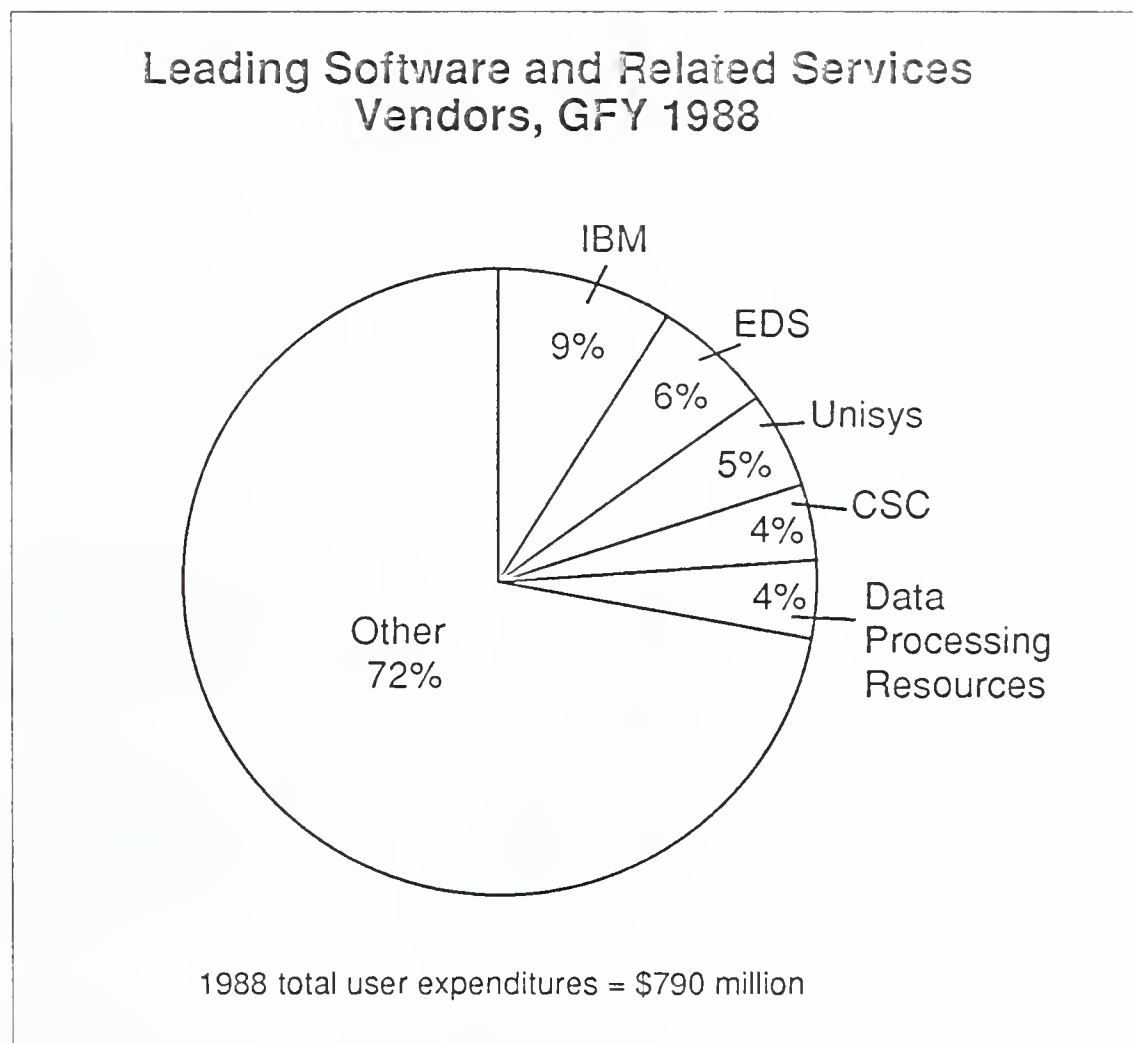
Hardware manufacturers and systems integrators head the market in terms of revenue. Based on INPUT's estimate of federal software and related services revenues, two hardware manufacturers (IBM and Unisys) and three systems integrators (EDS, CSC, and Data Processing Resources) are the leading vendors. Although not apparent in the exhibit, several niche vendors are starting to make significant inroads into the top

vendor listing because of their new technology offerings, replacing many independent software vendors.

G
Competitive Outlook

The competitive outlook is illustrated in Exhibit II-8. During the forecast period INPUT expects hardware manufacturers and systems integrators to retain their current dominant market presence. Market share, however, will likely change in response to the continuing trend toward systems integration by federal agencies.

EXHIBIT II-8

Competitive Outlook

- Hardware manufacturers and systems integrators remain dominant
- Influence of integration contracts
- Diminished direct product sales opportunities
- Constraints on software product revenues
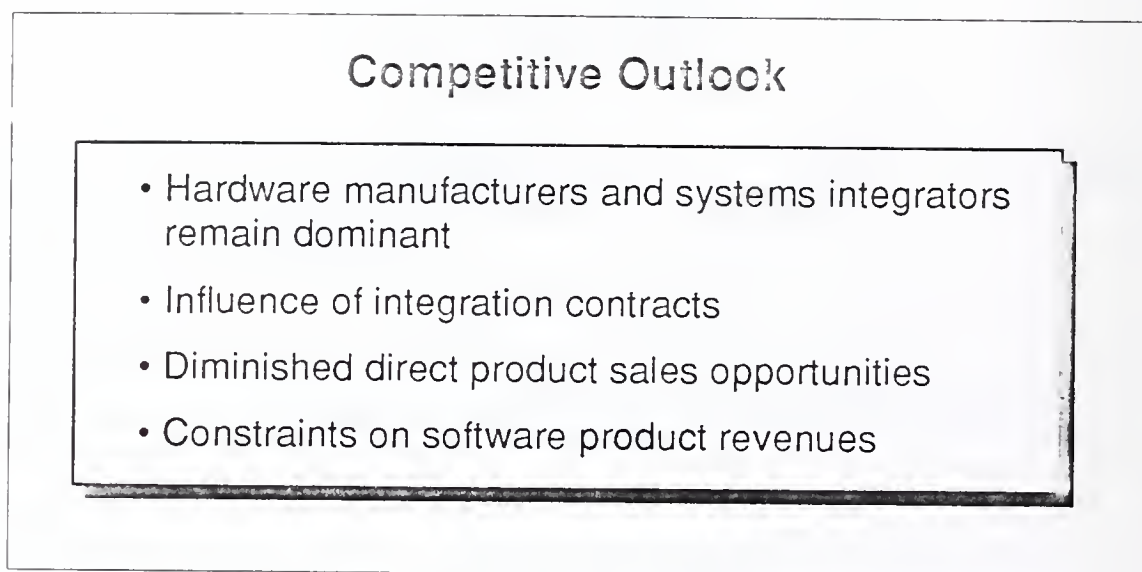
Hardware and software product vendors may find fewer direct product sales opportunities, but increased opportunities to place their products through systems integrators. Among the hardware manufacturers, only IBM seems well-positioned to gain from growth in systems integration services.

Despite rapid overall expansion in the software products market segment, individual vendors may not experience corresponding revenue growth. Heavy discounting, in many cases up to 50% off commercial pricing, and site-licensing pressures will moderate revenue growth.

H
Recommendations

In bidding software products to the federal government, vendors may need to adjust their marketing and product development strategies to align more clearly with buyers' expectations. One key issue is product commitment, where agencies seek concrete assurance that the product acquired today will be supported and enhanced over the years to come. This issue is becoming critically important to agencies, and software products vendors continue to merge and in some cases go out of business. Exhibit II-9 summarizes INPUT's recommendations.

EXHIBIT II-9

Recommendations

- Align marketing strategies with buyers' expectations
- Develop flexible teaming arrangements
- Investigate additional distribution channels
- Develop portable and interoperable products

Software product vendors need to focus on alternative distribution channels, such as systems integrators, to maximize market share. Revenue from one large-scale, multisite integration contract can easily exceed total annual direct sales from single product copies, as many recent umbrella-type contracts have shown. Software vendors should also increase their teaming relationships with professional services companies that are experienced in federal bidding.

Systems integrators gain a competitive advantage in pricing by building and maintaining long-term relationships with software product suppliers. Reduced development efforts through the use of packaged software modules and lower unit prices accompanying volume purchase contracts both act to hold down costs and improve margins. Vendors can expand their market shares by planning products and services to meet agency requirements for portable and interoperable systems. POSIX- and OSI-compatible products are federal standards that agencies increasingly will be required to adhere to as they strive to integrate applications across diverse hardware platforms. In some cases, agency customers may prove to be helpful in interagency marketing efforts.

III
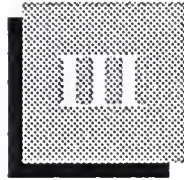
Market Analysis and Forecast

A

Market Structure

Software products, as a discrete delivery mode, is described in Appendix B of this report, with detail provided in Exhibit B-2. In general, INPUT divides this delivery mode between applications and systems software. Applications software includes typical applications such as accounting, human resources, procurement, and mission-support software. This latter category concerns software that directly supports the mission of the agency. The following examples are typical of applications software supporting mission activities:

- The IRS uses software to assess the auditability of the tax-payer's return.

- The DLA uses software to track the movement of supplies at depots and warehouses.

- NASA uses software to evaluate the usability of pictures transmitted from space.

Systems software usually sold along with hardware purchases includes operating systems to control the processor, compilers, DBMSs, charge back and resource accounting systems, and other program development tools.

Software development is a discrete subcategory under the professional services delivery mode (see Exhibit B-1 in Appendix B). These two categories, software products and software development, are combined in this report, because:

- Together they cover practically all software that vendors supply to the federal government.

- Most companies active in one delivery mode (in the federal market at least) are also active in the other delivery mode.

- Agency decisions to contract in these modes usually arise from the same set of circumstances and reflect the same internal and external pressures.

B
Market Forecast

The federal software market will grow from $1.97 billion in GFY 1989 to $3.38 billion in GFY 1994, at a CAGR of 11%. As illustrated in Exhibit III-1, the software products market will grow much faster than software development, practically surpassing software development by 1994. The software products market will grow at a CAGR of 17%, more than twice the rate of software development. However, because software development starts at such a large base ($1.25 billion), this market will continue to attract large numbers of vendors.

EXHIBIT III-1

Federal Software Market, GFY 1989-1994
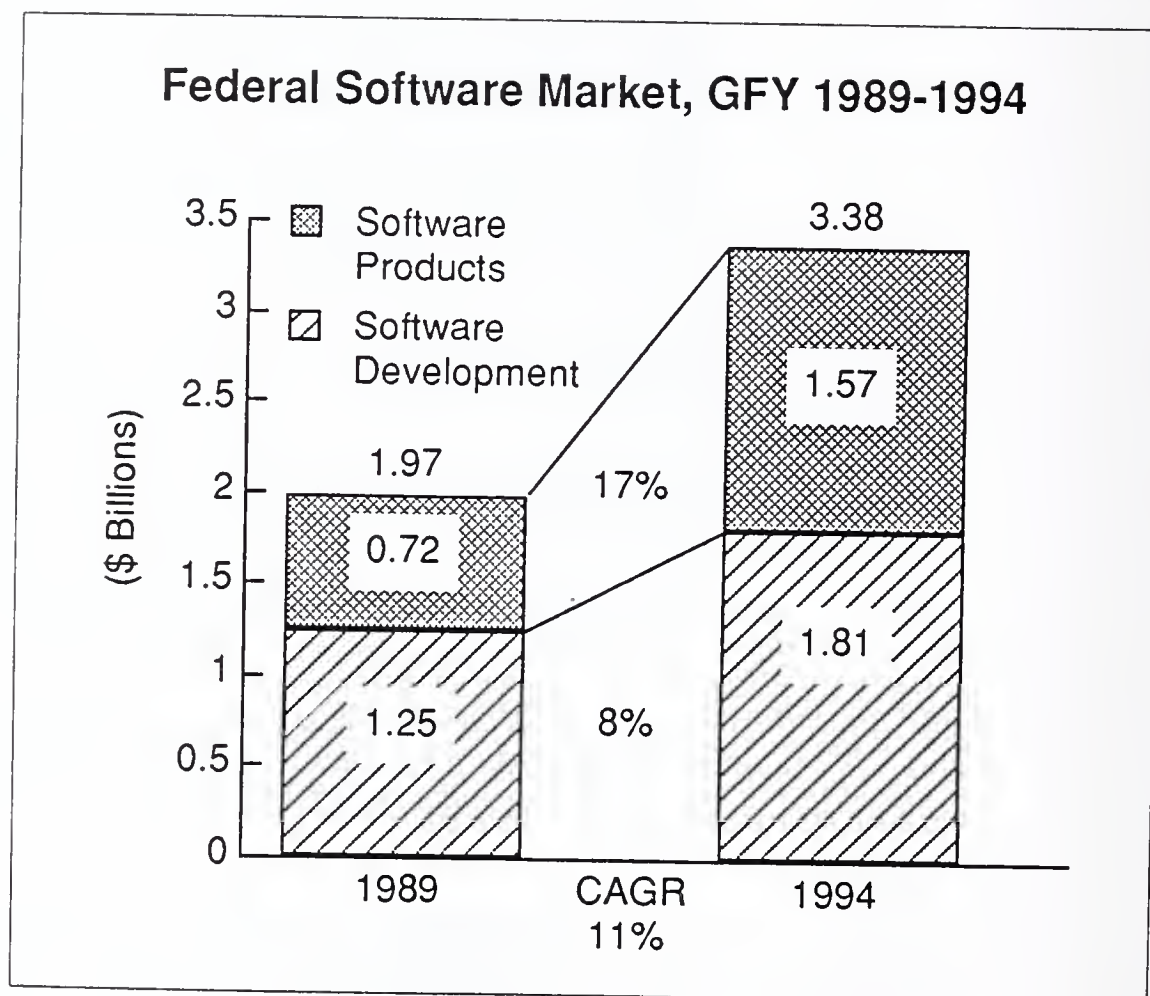
There are several factors driving the federal software market:

- Federal budget constraints are increasing the appeal of software products because, on a per-unit basis, they cost far less than custom software development.

- OMB has issued various guidelines encouraging agencies to acquire software products instead of software development.

- Various trends toward software certification, especially in the federal financial systems area, are starting to affect software sales.

- Agency users now have a far greater variety of products from which to choose, thanks largely to the greater functionality offered by the vendors.

- Software productivity tools, including 4GLs, CASE tools, Programmers' WorkBench, and Analysts' WorkBench, are facilitating program development by agency personnel.

- New and replacement software development is being driven in part by the (gradually) growing popularity of Ada.

- The growing popularity of requirements contracts for computer equipment, especially microcomputers, has spurred dramatic growth in the software products market.

1. DoD versus Civil Agency Forecasts

Exhibits III-2 and III-3 break out the federal software market into its civil and defense components. As in most federal delivery modes, the civil software market is larger than that in defense, by approximately 35%. The defense market is growing at a fraction of a percentage point faster than the civil market, due primarily to the fact that software products spending will exceed software development spending in 1994. Otherwise, the growth in these markets is fairly uniform.

EXHIBIT III-2

Civil Agency Software Market
GFY 1989-1994

EXHIBIT III-3

Defense Agency Software Market
GFY 1989-1994
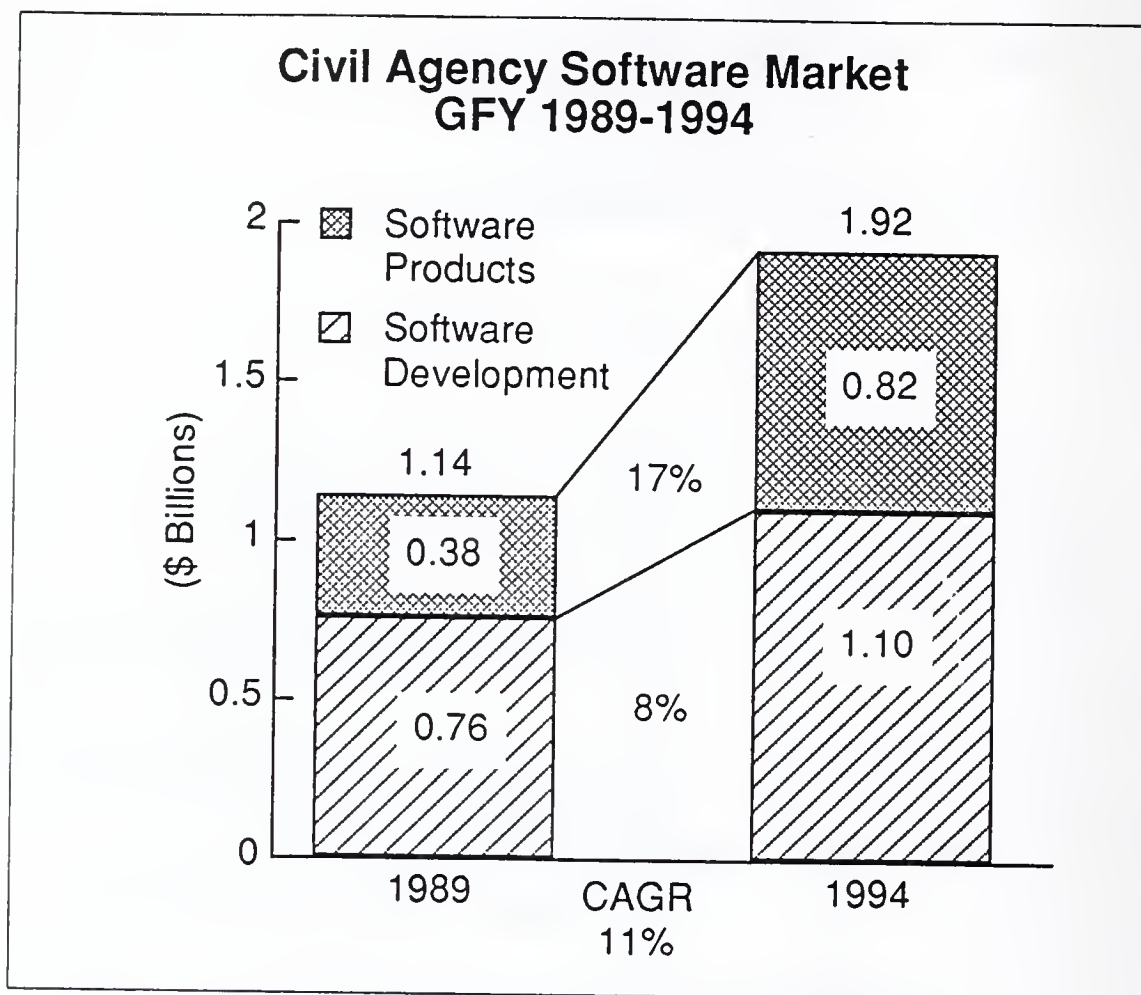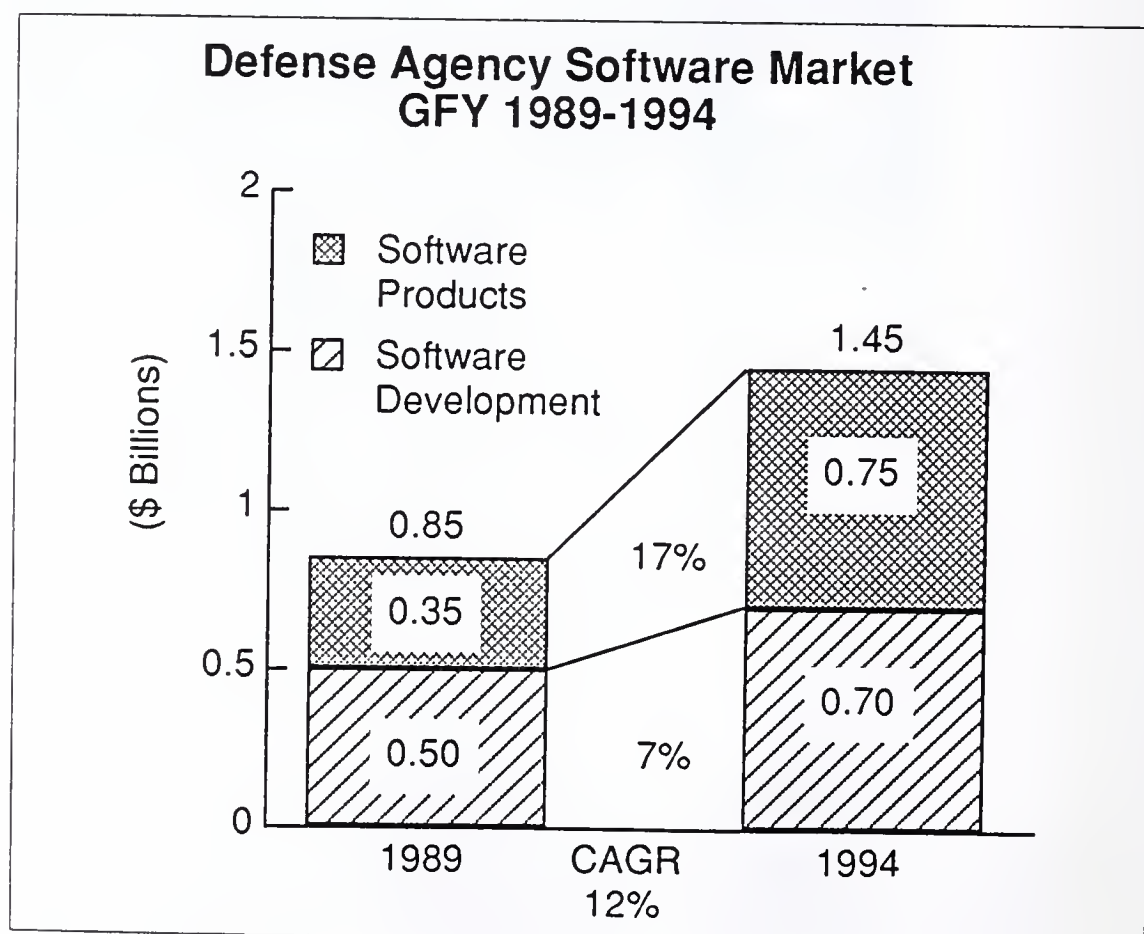
Exhibit III-4 compares spending for applications and systems software. Applications software is growing at a CAGR of 19% versus only 13% for systems software. Again, this growth reflects the increasing availability and functionality of applications software, as well as the need to control costs. Most of the applications software growth is coming at the expense of software development. In most cases, custom software development relates to applications, not systems software. Therefore, as the growth in custom software development slows, applications software products will grow at a faster rate.

EXHIBIT III-4

Federal Software Products Market
GFY 1989-1994
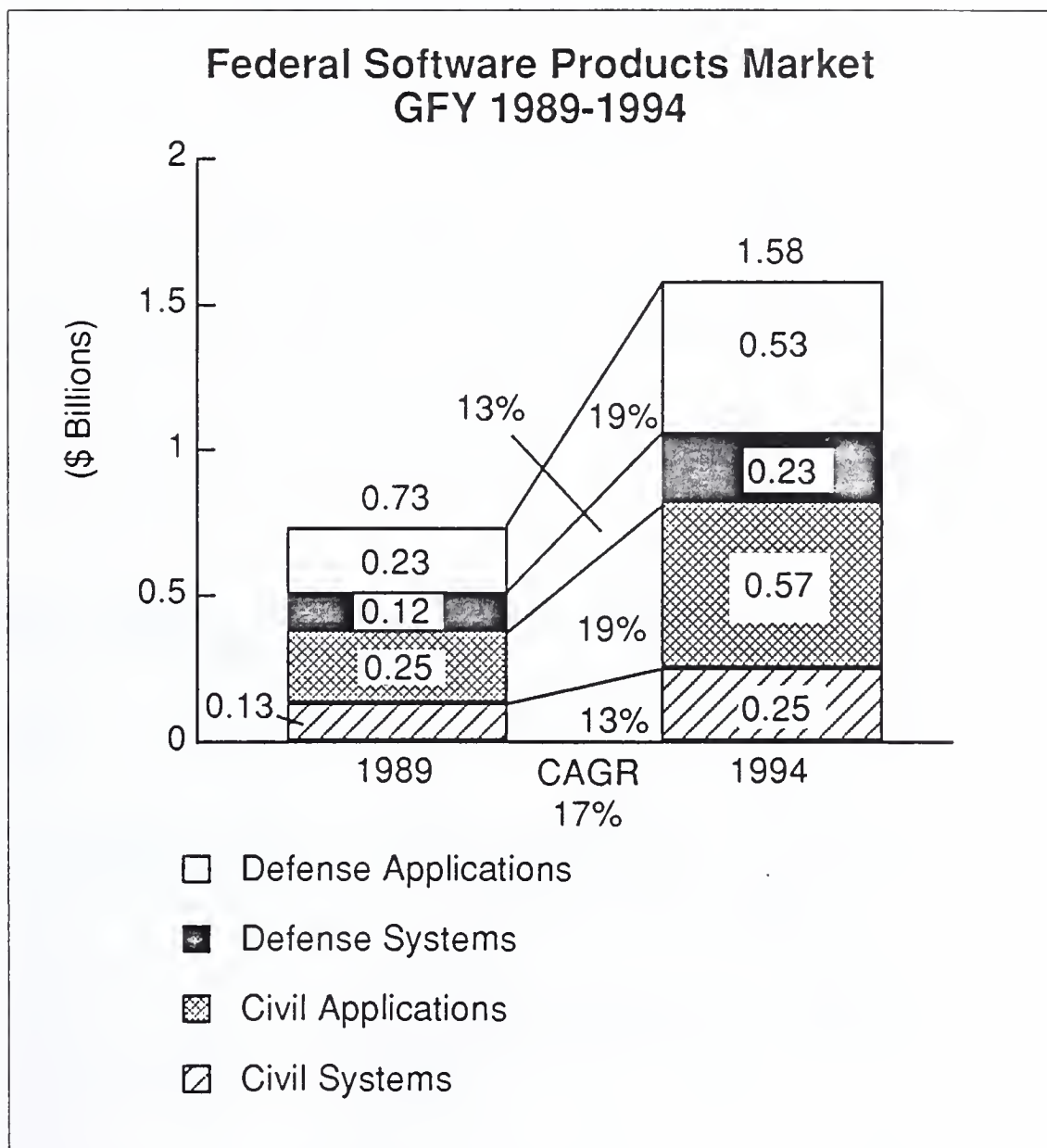
2. Agency Forecast

Agency software trends are shown in Exhibits III-5 and III-6. Agency GFY 1988 to 1990 budget requests for the line items "systems analysis and programming" and "software" are similar to INPUT's "software and related services" category of information systems.

EXHIBIT III-5

Defense Agencies' Software Budget Trends
GFY 1988-1990

Budget Line Items	$ Millions			CAGR 1988-1990 (Percent)
	1988	1989	1990	
Systems Analysis and Programming	880	864	964	5
Software (Capital Investment)	118	122	120	0.8
Total	998	986	1,084	4

EXHIBIT III-6

Civil Agencies' Software Budget Trends
GFY 1988-1990

Budget Line Items	$ Millions			CAGR 1988-1990 (Percent)
	1988	1989	1990	
Systems Analysis and Programming	917	1,040	1,105	10
Software (Capital Investment)	136	155	142	2
Total	1,053	1,195	1,247	9

Systems analysis and programming budget requests, which include custom software development, are growing at a compound annual growth rate of 5% for defense agencies and 10% for civil agencies. Although this represents a slight drop from fiscal years 1986-1988, at least this category of software is growing despite federal pressure on agencies to purchase more packaged software.

Capital investment funding for software purchases has dropped significantly for both civil and defense agencies. The CAGR for 1988 through 1990 for defense agencies is 0.8%, compared with 8% for the 1986 to 1988 period. Civil agencies have experienced a more dramatic decrease. During 1986 through 1988 they experienced a CAGR of 18%. This rate has now slipped to a mere 2% for the 1988 through 1990 period. However, based on identifiable initiatives from the various agencies, INPUT expects this market to start growing again.

Packaged software expenditures both for systems and applications software are included in budget requests under capital investment for software, lease/rental of software and "other" supplies, and operation and maintenance (for software maintenance). The budget items presented in Exhibits III-5 and III-6 (capital investment for software) are not inclusive of all packaged software acquisitions by federal agencies and do present a misleading view of the market. Software that is acquired through bundled purchases with hardware are not included in capital investment funding for software.

Funding requests for systems analysis and programming present a slightly different scenario. The CAGR for defense agencies has dropped slightly, to 5% for the current period, from a previous 7%. Civil agencies, on the other hand, have experienced a small increase, from 8% to 10%.

The overall CAGR for software for defense agencies is 4% for the 1989 to 1994 time period This represents a 3% decrease from the 1986-1988 forecast. Funding requests for civil agencies have at least remained steady at 9%. Agency funding requests reflect increased budget tightening pressures over the past few years, inspite of increased demands for software and software-related services. The picture for software is not expected to improve for agencies as long as the federal budget deficit controls continue.

Specific agency budget changes are presented in Exhibits III-7a and III-7b for software analysis and programming, and Exhibits III-8a and III-8b show capital investment trends for software.

Among defense agencies, the Air Force, Navy, and Army all have substantial systems analysis and programming budgets. But as mentioned previously, growth in budget requests over the last three years has been

EXHIBIT III-7a

Systems Analysis and Programming Budget Trends by Defense Agency GFY 1988-1990

Defense Agency	$ Millions			CAGR 1988-1990 (Percent)
	1988	1989	1990	
Air Force	459	448	527	7
Army	232	237	242	1
Navy	181	172	185	1
USMC	8	7	10	10
Total Defense	880	864	964	5

slow and will remain so for the forecast period. Despite slow growth, these agencies have represented significant opportunities for custom software services, with more than $950 million anticipated for GFY 1990. The unique nature of many defense agency missions will ensure a continued need for custom software development.

Systems analysis and programming budgets for civil agencies are smaller than those for DoD, except for NASA and Energy. Both of these agencies' CAGRs have risen slightly over the past few years. NASA's growth can most likely be attributed to increased emphasis on the space program. At first glance some of the CAGRs for many of the agencies indicate promising opportunities. Vendors should look at the overall dollars requested before assessing their software opportunities at any specific agency. Civil agencies represent better vendor targets for software lease/purchase than defense agencies in terms of total dollars requested in the budget at overall CAGR. DoD's growth is negligible. The data indicates that among the civil agencies, Interior, HHS, NASA, and Treasury will be the largest purchasers in 1990.

EXHIBIT III-7b

Systems Analysis and Programming Budget Trends by Civil Agency GFY 1988-1990

Civil Agency	$ Millions			CAGR 1988-1990 (Percent)
	1988	1989	1990	
Agriculture	26	48	45	32
Commerce	59	73	46	(12)
Energy	256	265	278	4
Education	5	10	9	34
Environmental Protection	19	32	38	41
GSA	4	2	2	(29)
HHS	54	46	65	10
HUD	20	22	27	16
Interior	15	22	25	30
Justice	16	18	21	12
Labor	17	14	10	(23)
NASA	330	390	417	12
State	18	20	21	8
Transportation	41	45	54	15
Treasury	36	32	44	11
Veterans' Affairs	1	1	3	73
Total Civil	917	1,040	1,105	10
Total Federal	1,797	1,904	2,069	7

EXHIBIT III-8a

Software (Capital Investment) Budget Trends
by Defense Agency, GFY 1988-1990

Defense Agency	$ Millions			CAGR 1988-1990 (Percent)
	1988	1989	1990	
Air Force	2	2	2	0
Army	37	37	47	13
Navy	68	67	61	5
USMC	11	16	10	5
Total Defense	118	122	120	0.8

EXHIBIT III-8b

Software (Capital Investment) Budget Trends by Civil Agency, GFY 1988-1990

Civil Agency	$ Millions			CAGR 1988-1990 (Percent)
	1988	1989	1990	
Agriculture	12	30	10	(9)
Commerce	32	16	8	(50)
Energy	3	3	5	29
Education	2	*	1	0
Environmental Protection	4	4	9	50
GSA	*	*	*	0
HHS	13	17	16	11
HUD	*	*	*	0
Interior	18	20	21	8
Justice	4	3	4	0
Labor	2	2	1	(29)
NASA	20	24	31	24
State	2	3	2	0
Transportation	11	13	13	9
Treasury	13	20	21	27
Veterans' Affairs	*	*	*	0
Total Civil	136	155	142	2
Total Federal	254	277	262	2

* = less than 1 million

C

Federal Market Issues
During the two most recent administrations, presidential task forces investigated the problems and technological status of the federal government's information processing resources. Findings are shown in Exhibit III-9. The investigation showed significant shortcomings:

EXHIBIT III-9

Federal Market Issues

- Slow to adopt new technology

- Obsolete ADP inventory

- Ineffective management of ADP resources

- Lack of technical staff
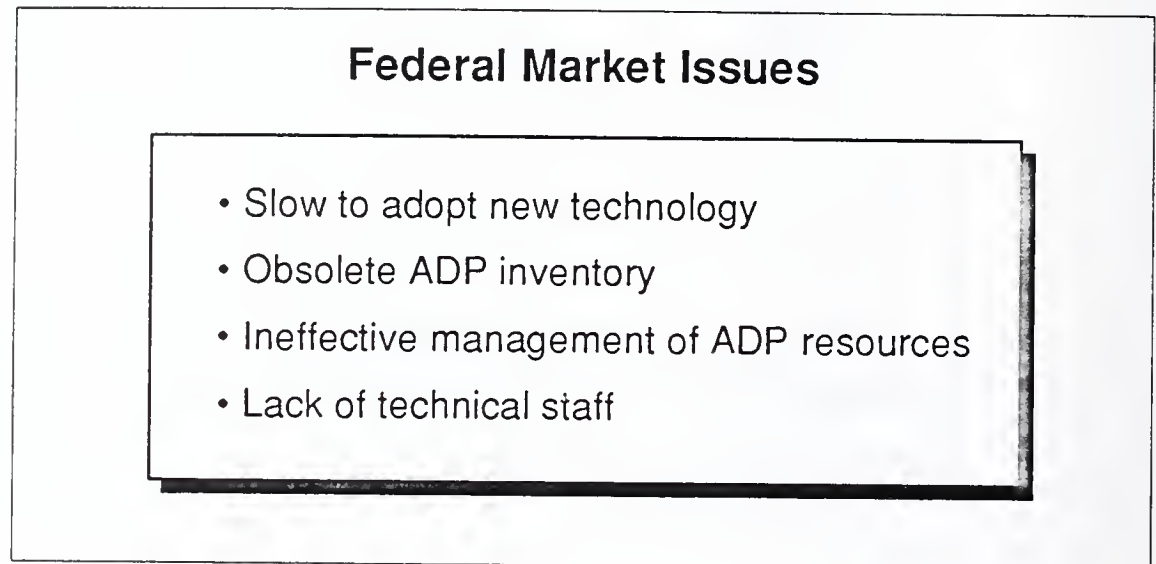
- The government has not taken full advantage of the technological advances of the private sector.

- A substantial amount of the ADP inventory, including software inventory, was already obsolete or rapidly becoming so.

- Federal executives have not managed ADP resources effectively.

- Federal personnel were not adequately trained in the use of information technology.

- Major initiatives were urgently needed to bring federal information management to the level needed for regulation, taxes, security, and services to the public.

These findings, along with some fundamental changes in GSA's information systems (IS) management policies, led to gradual changes in IS procurements, including software products and software development. In many cases, prototyping is replacing full life-cycle management in software development. The procurement changes, as well as the factors cited previously, have fueled the growth for federal software opportunities. INPUT expects this growth to be sustained for the indefinite future. Poor personnel practices also have supported this growth, particularly in the software development area.

Major civil systems affect service to the public and have greater political appeal than research programs. Deficit control measures, especially those under the Gramm-Rudman-Hollings (GRH) Act, are forcing agencies to cancel programs that do not meet stringent productivity improvement requirements and, in some cases, delay or stretch those that do. In some respects, Congress appears to be backing away somewhat from the GRH targets. However, at this writing, more than $16 billion in FY 1990 spending has been sequestered.

Systems acquisitions in the second half of the 1980s addressed needed improvements in management, administration, human resources, and logistics functions that have not received newer data processing resources in more than a decade. Many of these have been reflected in the focus of major systems procurements, which include software. Congress urgently needs more precise and timely data for the legislative process. Administration decisions require complete data on domestic issues and regulatory affairs in order to satisfy congressional mandates.

1. Historical Perspective

As noted earlier, there has been continuing pressure on agencies to contain costs by maintaining existing software and, when that is not possible, to acquire software packages rather than create new custom software. General Accounting Office (GAO) studies have assessed the experience of agencies over the last several years and have identified these problems.

- Agencies spend considerable amounts of programming time and funds on outside contracts to maintain software, but the maintenance process is frequently under-managed. Lack of uniform definitions and control of costs are two of the problems frequently cited.

- The General Accounting Office has noted insufficient testing of software during development and installation. The establishment and compliance monitoring of testing policies as well as the more frequent use of automated tools and testing techniques would, in the GAO's opinion, reduce the more expensive procedure of correcting errors after the software is in operation.

- Also, the GAO has reported dramatic cost and schedule overruns in software development. Frequent problems include premature contracting before agencies fully understand what they need, missing or inappropriate performance criteria, inadequate management of the development process that results in missed agency-vendor communications, and failure to inspect contractors' work at intermediate stages.

To some extent, the federal contracting process has contributed to these problems. In past years, federal ADP and telecommunications systems

were procured and managed for more than two decades by the FPRs, FPMRs, and ASPRs. ADPE and services procurements, including software, were modified by the 1966 Brooks Act and subsequent amendments.

The Paperwork Reduction Act of 1980 included a number of provisions concerning information resource management and system acquisition. The Act:

• Created the office of Information Resources Management in each department and major agency.

• Placed all but sensitive and mission-essential ADP under a new "Mini-Brooks Bill."

• Provided a separate approval procedure for national security and defense-mission ADP.

• Authorized annual preparation and publication of a Federal Agency Five-Year Plan for major ADP/Telecom Acquisition by OMB and GSA.

Few pure software contracts appear in agency budget documents, because spending is not usually high enough to exceed the reporting threshold. Often, however, software is coupled with hardware, SI, or other purchases. Also, major software developments usually are included in the budgets.

Under the authority of the Federal Administration Act and the Paperwork Reduction Act, GSA prepared and made effective in April 1984, a new regulation for information systems. The Federal Information Resource Management Regulation (FIRMR) superseded the FAR and FPMR in information technology areas. GSA intended that the FIRMR would streamline the information resources acquisition process. GSA recently completed a rewrite of FIRMRs to reflect significant legal and regulatory changes, as well as to expedite procurements. However, with different versions of a new Paperwork Reduction Act pending in Congress, the FIRMRs will likely require further rewrite.

Other regulations and policy initiatives that are changing the acquisition procedures include the following:

• The Competition in Contracting Act (CICA) of 1985 proved that expanded legal powers for ADP protest action via the GSA Board of Contract Appeals (GSBCA) and GAO increased the opportunity to employ negotiated contracts and established seven more restricted categories of exceptions that permit sole-source awards. Agencies view the CICA as allowing vendors to complicate and lengthen the

acquisition process. The act's provisions make it easier for vendors to protest procurement activities and bring temporary halts to procurement schedules. Virtually every major procurement, including those for custom software development, has been protested under the CICA.

• The Paperwork Reduction Reauthorization Act of 1986 expanded the power of the GSBCA, but also retained the Warner Amendment, which provides DoD with mission-critical ADP procurement exemptions to the Brooks Act Coverage, except for application of general-purpose ADPE in noncritical functions such as testing, recalibration, and programmer workbenches.

At this writing, the Paperwork Reduction Reauthorization Act has expired without replacement legislation being passed. A dispute arose between Congressman John Conyers, Chairman of the House Government Operations Committee and Congressman Frank Horton, the ranking Republican on the committee. The dispute concerned the adjudication power of OMB's Office of Information and Regulatory Affairs (OIRA). Both congressmen submitted their own bills. In addition, Senator Jeff Bingaman submitted a third version of the bill. INPUT expects a Reauthorization Act to have passed in some form by the end of calendar year 1989. While OIRA may not lose any power, its accountability to the Congress may strengthen somewhat.

Several other issues have arisen that are now being studied. These include software rights, data rights, and second-sourcing of some systems. INPUT expects these issues to continue to create problems on some hardware procurements and, by implication, on software licensing arrangements.

As is well-known in the vendor community, the CICA has not achieved what was expected. It was expected to improve competitive opportunities, while the GSBCA provided more equitable adjudication of claims. Today, virtually all major procurements are protested. A new word has entered the federal procurement vocabulary—fedmail. Some agencies and winning vendors are providing payments to protesters in order to secure withdrawal of the protest. As a result, a new growth industry is developing for lawyers specializing in federal procurement. GSA's most recent studies suggest that fedmail is becoming less common, although it has not yet disappeared completely.

Most successful protests result from one or more of the following defects:

• Failure to follow stated evaluation plans
• Procurement process inconsistencies
• Improper documentation
• Defective pricing
• Inconsistent information dissemination

GSA's limited procurement review of the past few years has eliminated much of the expert examination of procurement actions. Many vendors now believe that more review is needed. Some have even indicated that, in certain circumstances, losing can be more profitable than winning.

A new office in GSA has begun issuing quarterly reports on GSBCA activity. Based on analyses of protest decisions, it is apparent that evaluation procedures represent the biggest source of trouble. If agencies lock themselves into too tight an evaluation model, any deviation usually results in a sustained protest. Therefore, GSA has recommended more flexible evaluation models that give the selection official and contracting officer more latitude in comparing cost and technical considerations.

2. Impact on Software Procurements

As a result of these and other developments, software acquisition procedures are expected to undergo some transition in the coming years.

- The Army prepared new software support contracting standards (DoD-STD-14676-AR) for DoD-wide application.

- Navy Data Acquisition Command (NAVDAC) instituted benchmark procedures for software packages that are specified in future ADPE acquisitions.

- Defense Acquisition Council to the Federal Acquisition Regulations presented changes to the FAR concerning the government's technical data and software rights when the government contracts for development. Subsequent rejections by OMB led to a softened position in early 1987, but this remains an area of continuing controversy. The Air Force Desktop III procurement had some conflicts this year over software data rights.

- GSA instituted more stringent vendor financial and maintenance requirements for software offered in GSA computer stores and on FSS schedules.

- A change to the FIRMR allows each agency to select an acceptance criterion that is appropriate to the economic and performance risk of specific applications.

- Changes in both the Federal Supply Schedules and the Federal Acquisition Regulations in 1986 required vendors to offer packaged software at the lowest "best client" discounted price or to demonstrate the commerciality of the product to support catalog prices. Recently, the government successfully prosecuted a small firm for providing lower prices to its commercial clients.

OMB A-130, "Management of Federal Information Resources," established the policy of choice for software packages over custom development and encouraged use of nonprocedural languages and modern software engineering techniques to improve maintainability. This policy has been extended throughout agency software acquisitions.

In its fiscal year 1986 budget hearing before Congress, DoD noted its intentions regarding software acquisitions, evaluation, and use for programming aids:

- Use integrated and automated software tools and programming aids.

- Reuse, where possible, previously acquired software packages.

- Transfer, as soon as practical, the software development technology from the Software Institute to both in-house and contractor practices.

Subsequent budget documents have strengthened this policy. Further, through software certification initiatives such as the Joint Financial Management Improvement Program, OMB is further promulgating the use of packaged software.

In responding to recent congressional calls for better ADP planning, DoD will clarify its intentions on these issues. The following methods are being initiated at federal agencies:

- The Bureau of Reclamation's personnel and payroll system is used by the Department of Energy and Education.

- ACTION contracted for the modification of an existing accounting system, saving 75% of the development cost and time to build a new system.

- Many agencies use software available from the National Association of State Information Systems.

3. Budgetary Constraints

Future-year funding of current acquisition programs and approval of funding for the next budget year are always in doubt in the federal government market. The authorization of an agency budget and the requested information resources by the agency oversight committee do not assure the agency or vendors that funds will be provided in the out-years. Appropriation acts for the agencies approve the Total Obligational Authority (TOA) for certain large systems, but not the fiscal year or years in which the funds will be available (called outlays). For software purchases, however, this will have little effect.

Continuing economic and political sensitivity to the large national budget deficit could negatively impact a number of acquisitions in the less-than-critical defense and civil technology sectors. The current budget sequestration for FY 1990 will likely affect these areas, should it stay in effect. Major ADP systems already approved are likely to continue in preference to unapproved programs.

Major civil systems affect service to the public and have greater political appeal than research programs. Deficit control measures, especially those under the Gramm-Rudman-Hollings (GRH) Act, could force agencies to cancel programs that do not meet stringent productivity improvement requirements and, in some cases, delay or stretch those that do. However, Congress appears to be backing away somewhat from the GRH targets, and most agencies have not yet experienced any major effect from the Act. The current budget sequester might change that.

Systems acquisitions in the second half of the 1980s have been addressing needed improvements in management, administration, human resources, and logistics functions that have not received newer data processing resources in more than a decade. Many of these acquisitions include operational support. Administration decisions require complete data on domestic issues and regulatory affairs in order to satisfy congressional mandates. Agency executives need trend analyses and status reports that accurately portray funding, staffing, and performance progress against mission objectives. Required are accurate, up-to-date information management systems that provide the desired level of cost-effective computing capability.

Budget difficulties should continue to constrain the federal information systems market, particularly on the defense side. However, if the procurement process is simplified to reduce the protest volume, acquisitions should begin to increase. Many view information systems as key to productivity increases. Therefore, budget constraints sometimes lead to increased opportunities in the information systems market. Defense may find savings through more operational support contracts.

4. Software Integration and Productivity Improvements

Software is the interface medium between machines, applications, and end users. Agencies need strategies and vendor support to implement these integrations. Agency respondents in previous studies noted a growing need for portable software that is readily adaptable to a changing hardware environment. As new hardware technologies are put in place, the next generation of software must accommodate change and communications between incompatible equipment.

Processing vendors must offer new and innovative software to win market share, including the following:

• Programmers' workbench
• Artificial intelligence
• CASE technology

Similarly, agencies are increasingly required to merge large applications into a single, transparent software system that fits their end-users' needs, rather than government end-users adapting their needs to the capabilities of the software.

To modernize software and thus effect productivity improvement, agency ADP organizations are seeking greater use of:

• Software engineering technologies, including more efficient software management methods, software development methodologies, and data dictionaries

• Higher-level development tools, including program generators and fourth-generation languages

• Better analytic tools for all sizes of machines—microcomputers, midsize computers, and mainframes—that will provide programmers with development aids such as automatic documentation, cross-referencing, etc.

One approach—data administration—provides techniques and software tools for arranging large amounts of data. By organizing, indexing, and cross-referencing data according to the business requirements of the organization, agencies are better equipped to plan procedures for the comprehensive development of future systems. Specifications from the American National Standards Institute (ANSI) are now being reviewed by agencies and vendors. Although a standard data dictionary software specification is some years away, vendors, especially of data base management systems (DBMSs), need to be cognizant of the pending impact of this trend.

Fourth-generation languages (4GLs) are being employed by agencies to increase productivity in software development and maintenance. Processing services arrangements allow agencies to try out new software without making a major financial commitment. Currently, 4GLs are used primarily for end-user computing and reports, along with some decision support. Other applications for 4GLs are being designed and will eventually ease the burden on agency staff. Government computer resources experts are concerned with the demand on computing capability of 4GLs and will look for 5GLs with improved efficiencies. Many information systems procurements include requirements for 4GL experience. Ad-

vanced hardware designs, including reduced instruction set computing
(RISC), will make traditional (and inefficient) 4GLs more feasible.
Hardware inefficiency will matter less than it used to.

The Programmer Workbench (PWB) concept has been sponsored by the
GSA's Federal Software Management Support Center. To date, two beta
tests have been established (SSA and DLA), the products have been
selected, and contracts are in place for agencies to purchase these prod-
ucts from GSA. If successful, the program will be expanded to include
not only the entire IBM software management suite, but also non-IBM
environments.

Rand Information Systems won the contract to design and implement the
infrastructure. Other vendors are providing software products through an
indefinite quantity contract with GSA.

A generalized model of a computer-aided software programming work-
bench is depicted in Exhibit III-10. However, programmer workbench
technology has not spread as rapidly throughout the government as GSA
had expected.

EXHIBIT III-10

Generalized Programmer WorkBench

Graphics Screen

Specification and Documentation Tools

Design Analyzer

Code Generator Formatter Cross-Reference

Library of Processes, Procedures, Data Models, Business Model, Data Dictionary
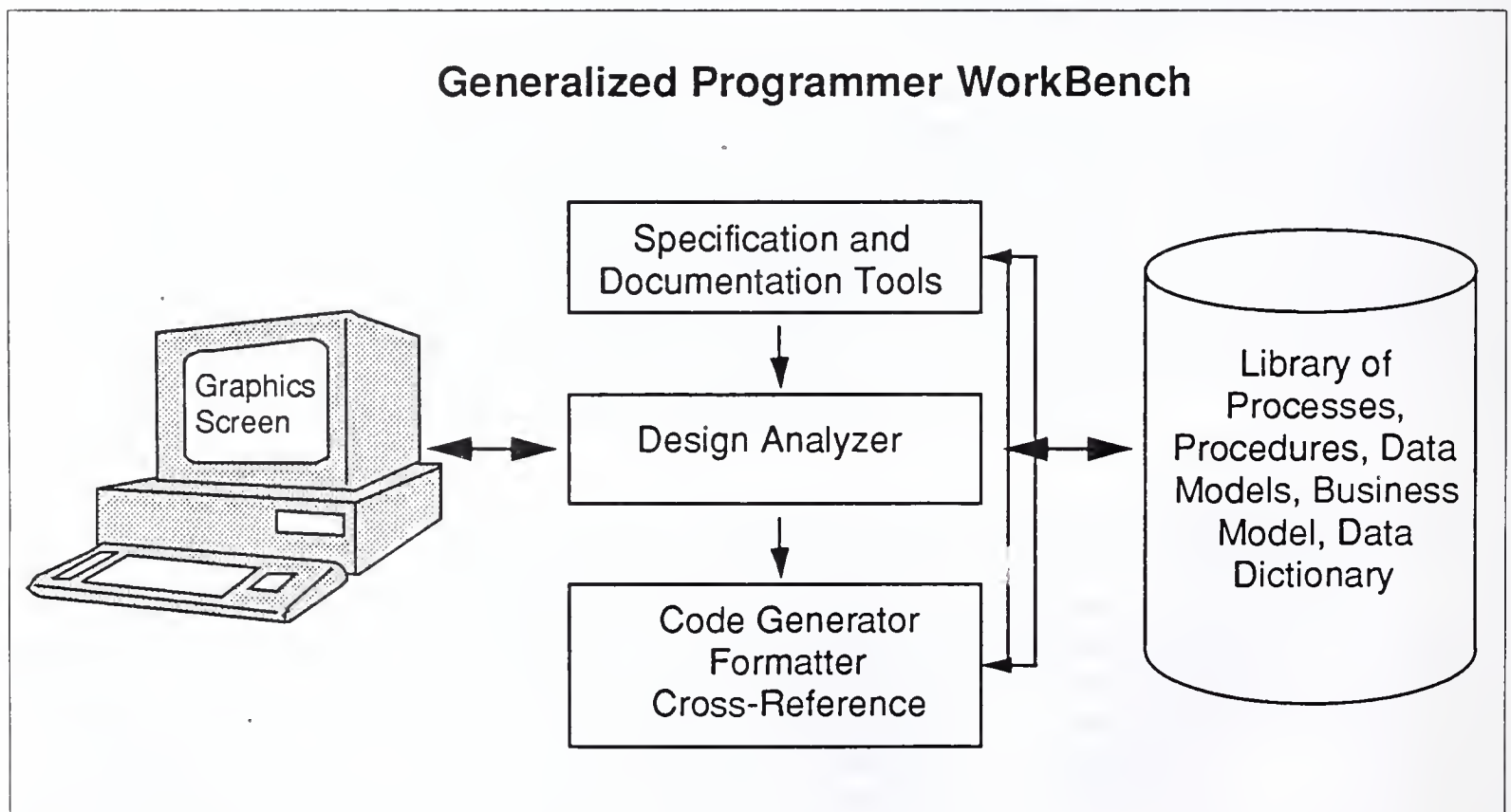
5. Artificial Intelligence

Artificial intelligence (AI) is a market segment in which vendors are focusing on the introduction of new technology to the government, primarily in the areas of software development efforts and decision support. Currently, expert systems (which are a popular subset of the family of AI capabilities) are being developed by agencies as standalone end-user production systems to automate knowledge-based processing. In meeting federal operational support needs, vendors must often include AI features as part of their offerings.

The DoD is taking the lead in developing AI programs. Artificial intelligence is providing useful training for analysts, and applications are being employed in tactical situations and support functions. Civil agencies also are developing and operating expert systems for large-scale information processing. In a previous INPUT report, decision-support systems were rated as representing the most common government application of AI. However, AI also is being used in the development of microcomputer security products.

Industry views the current AI opportunities to be in product-oriented services for prototype systems for the federal agencies. As in other software areas, the government is looking to industry for solutions, not just products. Therefore, in response to this trend, AI vendors are expected to migrate beyond standalone systems to new products that integrate approaches and solutions. Artificial intelligence is expected to aid in developing closer links to the main flow of an agency's information processing.

Many small AI vendors are focusing their marketing efforts on IS directors and are providing products to facilitate information storage and retrieval, data communications, and other typical management functions. Current federal prototyping efforts are demonstrating AI feasibility in those IS functions as well as other decision-support areas. Areas in which federal workers must interview the public seem especially promising for AI. In a previous INPUT report, it was noted that many federal AI applications were being applied to specialized, midsize computer systems.

6. The UNIX/POSIX Solution

An issue of concern to agencies is the interoperability of software across different vendors' hardware. Some agencies believe that UNIX-based products provide a partial solution to this problem. As depicted in Exhibit III-11, UNIX offers a common operating environment for all sizes of hardware, from mainframes to microcomputers.

EXHIBIT III-11

Evolution of Operating Systems Standards

Mainframe   Vendor Proprietary

Mini   U N I X

Micro   MS DOS
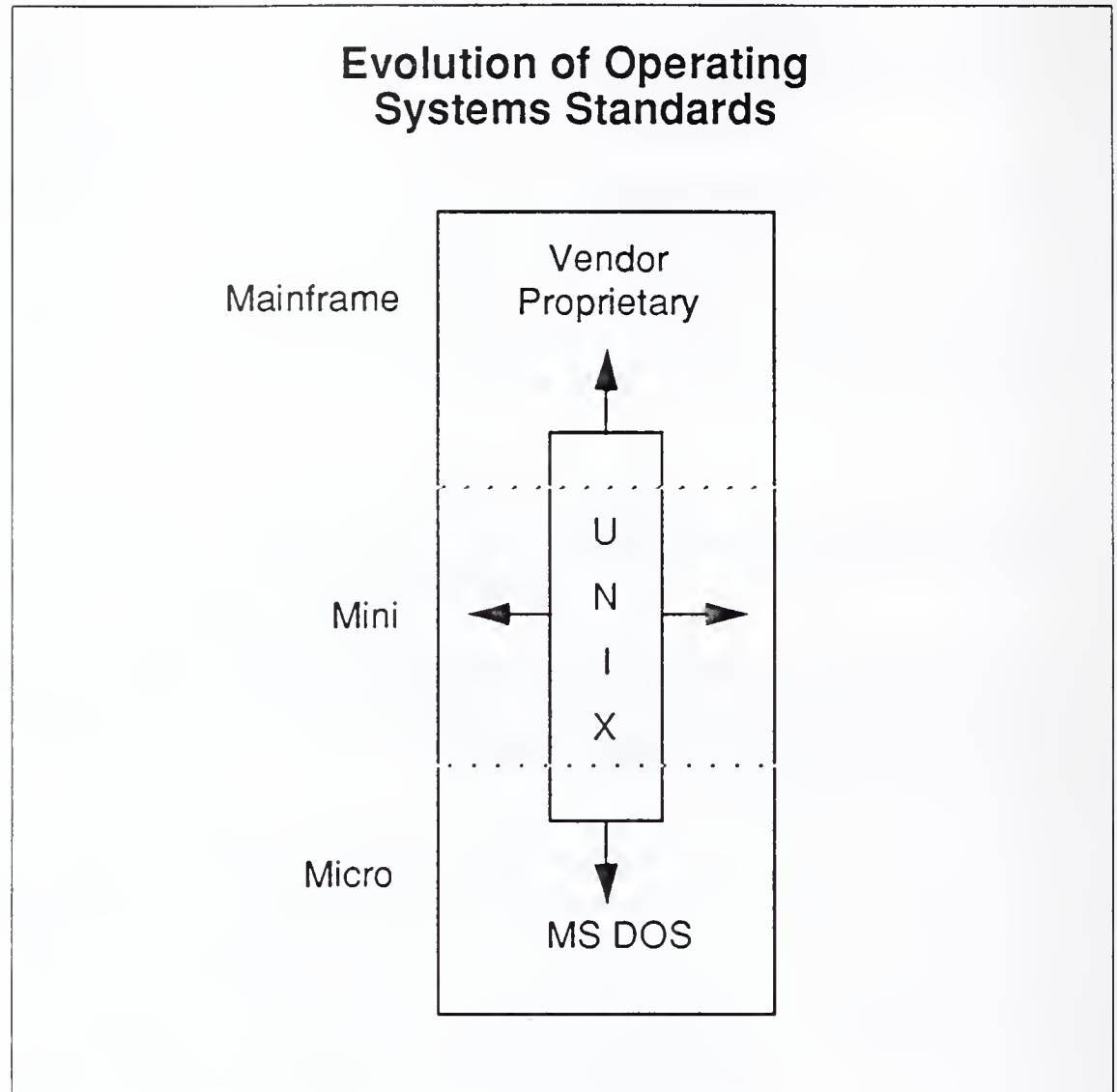
References to a POSIX standard are now seen more frequently, although many authorities doubt the frequently quoted figures that 65% of the upcoming specs will use UNIX.

- The Army's information systems standards include UNIX at both the organizational and work-unit level. These standards are shown in Exhibit III-12.

- The Army's Command and Control Systems (ACCS) will use Uniplex Business Software, which is UNIX-based office systems software.

- The NIST is looking for organizations interested in evaluating its new test suite for the revised POSIX application-to-operating-system interface standard.

- The IRS is using a UNIX-based system from Sequent Computer Systems to support its taxpayer services functions.

EXHIBIT III-12

Army Information Systems Standards

Tier I - Regional Processing

Operating System	- MVS
Data Base Management System	- Any DBMS with SQL Interface
Hardware	- No Standard Defined

Tier II - Installation/Organizational

Operating System	- UNIX5; or VM able to host CMS/VSE/MVS/UNIX5
Data Base Management System	- Any DBMS with SQL Interface
Hardware	- No Standard Defined

Tier III - User Processing

	- UNIX5 or MS-DOS
	- No Standard Defined
Operating System	- PC Shall Be IBM-Compatible
Data Base Management System	
Hardware	

Communications: Tiers I and II will be able to use IBM Systems Network Architecture (SNA) or SNA gateway with remote job entry (RJE), 327X emulation, and document interchange/document content architecture (DIA/DCA) and option for DoD protocols.

Artificial Intelligence (AI): Workstations for AI applications will be able to support "common LISP."

Source: DAIM-AD
(Department of the Army Information Management)

- AT&T's Air Force contract for midsize UNIX-based systems, the Standard Multiuser Small Computer Requirements Contract, may lead to wider acceptance of UNIX throughout the government.

- NASA's Goddard Space Flight Center is working with a private firm, Century Computing, Inc., to use UNIX in designing application user interfaces.

However, differences persist among vendors on various implementations of the POSIX standard, and these differences will retard the interoperatibility requirements of agency executives.

These issues will not be solved readily and the evolution of a UNIX standard will compete with other approaches to software modernization, including fourth and fifth-generation languages, data administration technologies and programmer's workbench products.

D

Federal Software and Related Services Vendors

The enormous size of the federal market and the vast spectrum of products and services acquired attract a host of vendors. Whether covering a breadth of offerings or serving a niche, large and small vendors to the federal government must be counted among the competition. Numerous acquisition channels (GSA programs, sole-sources, competitive bids) and a regulatory structure intended to ensure equal opportunities for vendors, provide vendors with attractive opportunities. However, the reality of the software and related services market is that a significant share is held by a few vendors.

- In the software products segment, the market is dominated by mainframe hardware vendors, primarily on the strength of their accompanying systems software. Independent software product suppliers form a distant second-tier group.

- Similarly, software development revenue from the government is largest for major systems integrators that can offer a wide range of professional services. Niche vendors that target specific applications, operating systems, etc., form the second tier.

The federal government as an entity is the largest purchaser of professional services and thereby attracts the widest range of vendors by size and specification. Exhibit III-13 indicates the leading vendors by market share to the extent that this portion of their federal revenue is identifiable.

EXHIBIT III-13

GFY 1988 Estimated Top 20 Software Products Vendors
Revenue and Market Share

Vendor	Federal Software Products ($Million)	Federal Software Products (%)	Federal Software Development ($Million)	Federal Software Development (%)	Total Federal SRS ($Million)	Total Federal SRS (%)
IBM	21.0	10	49.8	9	70.8	9
EDS	20.3	10	24.4	4	44.7	6
Unisys	15.7	7	25.6	4	41.3	5
CSC	0	0	29.2	5	29.2	4
Data Processing Resources	0	0	28.0	5	28.0	4
E. Systems	0	0	24.3	4	24.3	3
Arthur Andersen	0	0	23.7	4	23.7	3
TRW	0	0	22.7	4	22.7	3
Computer Data Systems Inc.	0	0	21.1	4	21.1	3
Daedalean, Inc.	0	0	13.8	2	13.8	2
DEC	13.4	6	0	0	13.4	2
PRC	1.8	4	10.3	2	12.1	2
Atlantic Research Corp.	0	0	11.9	2	11.9	2
Sterling Software Inc.	6.2	3	4.9	1	11.1	1
Honeywell	2.2	1	8.3	1	10.5	1
Thinking Machines Corp.	10.2	5	0	0	10.2	1
Syscon	3.4	2	5.8	1	9.2	1
CDC	8.6	4	0	0	8.6	1
Raytheon	0	0	8.0	1	8.0	1
Computer Research	0	0	7.5	1	7.5	1
Other	110.6	52	256.8	45	367.4	47
Total Software Related Services	213.4	100	546.1	100	789.5	100

Source: Ziff-Davis Pinpoint, 1989, GFY 1988

Note: Percent columns do not add to 100% due to rounding

Until now, the market has been dominated by systems integrators and traditionally perceived hardware firms. These firms possessed a broad range of in-house or consultant skills that met previous software development and implementation requirements. The types of firms gaining federal software market share are changing, as will be discussed later in this report. Examination of vendors' revenue and market share, based on the Federal Contract Awards Data Base, shows the decline of systems software firms. Systems integrators and purveyors of niche products are significantly penetrating the federal market. Hardware firms continue to hold their positions by providing systems software, with applications software packages and software development as secondary lines of business.

In the previous release of this report, independent software vendors showed strong market presence in this market segment. Systems integrators have replaced the independent software vendors as a major source of software products to federal agencies. The shift in vendors offering products in this market is a result of a combination of the following factors:

- The federal government's increased reliance on single contractors that can provide a variety of products and services

- Contractors expanding their product lines to increase revenue shares

- A lessening of the number of independent software vendors as a result of corporate mergers and acquisitions

- The growing use of VARs for software products on GSA schedules, including sometimes multiple VARs for the same software products.

Many of the respondents in this study traditionally perceived as hardware vendors now categorize themselves as integrators. Firms that also would have been identified as professional services companies also viewed themselves as integrators. Respondents' perceptions of themselves reflect the changing nature of vendors in the information systems marketplace. In order to retain and increase market share, vendors are widening their product and services offerings. INPUT now finds that, under certain circumstances, practically all companies call themselves systems integrators.

E

Federal Ada Market

In 1975, the Department of Defense (DoD) began a project to develop a new, high-order language, initially intended to support embedded computer systems. Two years later, using a typical try-before-you-buy approach, DoD awarded four contracts to different firms to design, in parallel, this new language. Two of these vendors were chosen to continue their work beyond the preliminary design stage. Finally, in 1979,

the DoD awarded a contract to Cii-Honeywell-Bull to develop the new language, subsequently called Ada. The American National Standards Institute approved Ada in 1983, with the International Standards Organization following with its appproval in 1987.

Despite its slow start, Ada is now becoming a major force in the federal information systems market. The Ada market is discussed in this section, and a brief summary on the policy and technical issues, as well as highlights of a few applications are provided.

1. Market Forecast

The federal Ada market (covering equipment, software development, and software products) will grow from $249 million in 1989 to $387 million in 1994, at a CAGR of 9%, as seen in Exhibit III-14.

Federal Ada Market, GFY 1989-1994

Legend:
- □ Software Products
- ▨ Software Development
- ▱ Computer Equipment

	1989	CAGR 9%	1994
Total	249		387
Software Products	32	9%	50
Software Development	66	10%	104
Computer Equipment	151	9%	233
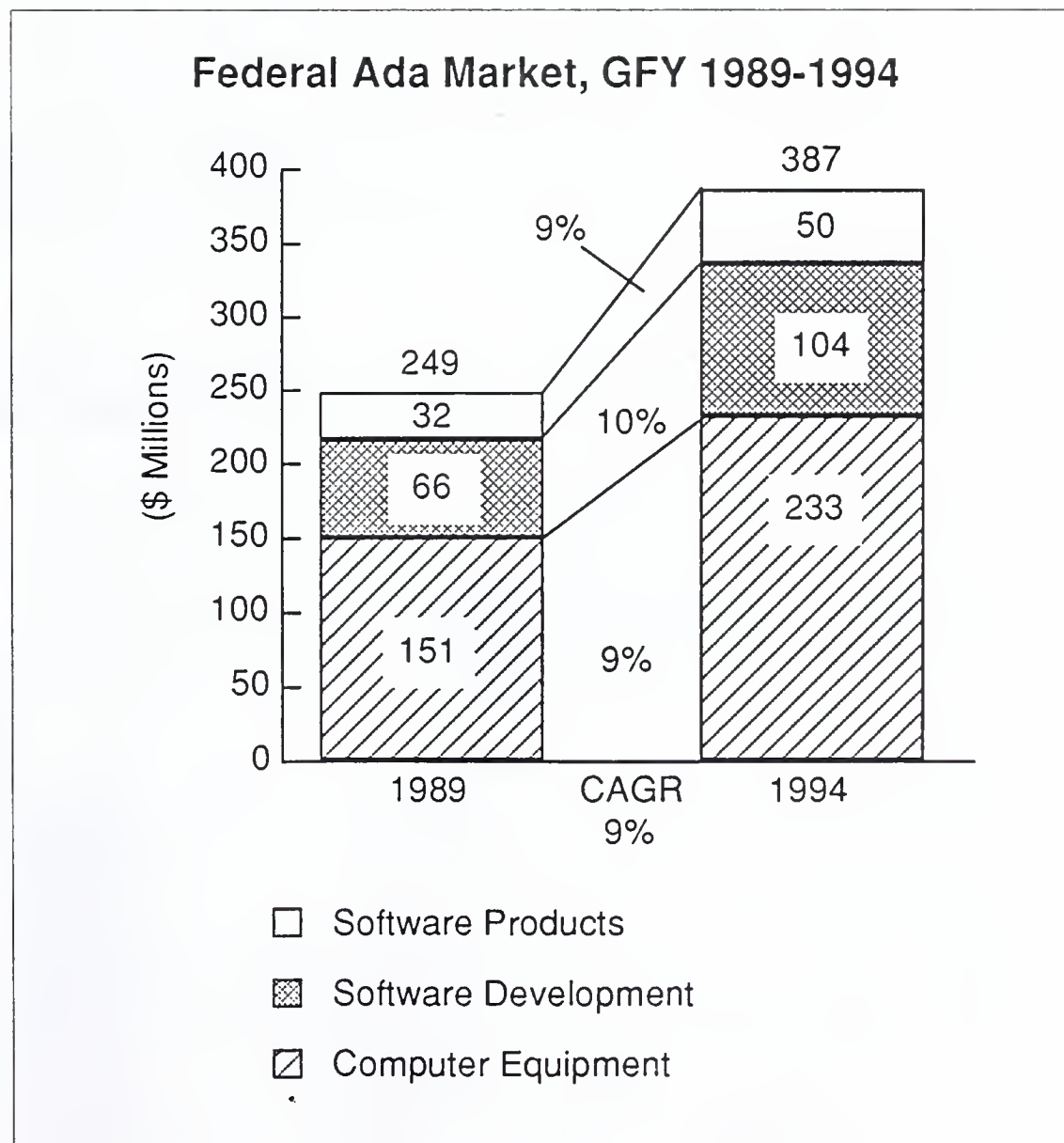
This forecast reflects the growth in federal spending on computer systems using Ada software. Despite the relatively uniform growth of the three categories, they really reflect three sets of issues:

- The federal computer equipment market, overall, is growing at a CAGR of only 5%. Ada-related equipment is growing twice as fast, reflecting the hundreds of projects in development that require equipment.

- The federal software development market, overall, is growing at a CAGR of only 8%. Ada-related software development is growing slightly faster, reflecting the increasing number of programmers who are trained in Ada and the need to develop new, custom solutions on most Ada projects.

- The federal software products market, overall, is growing at a CAGR of 17%. The Ada-related software products market is growing only half as fast, reflecting the ready availability of compilers, which have so far been put to limited use.

According to the Ada Joint Program Office (AJPO), there are now 266 available Ada compilers (Exhibit III-15). This growth should level off, as most hardware platforms have already developed Ada compilers.

EXHIBIT III-15

Validated Ada Compilers, 1983-1989

Source: *Ada Information Clearinghouse Newsletter,* September 1989
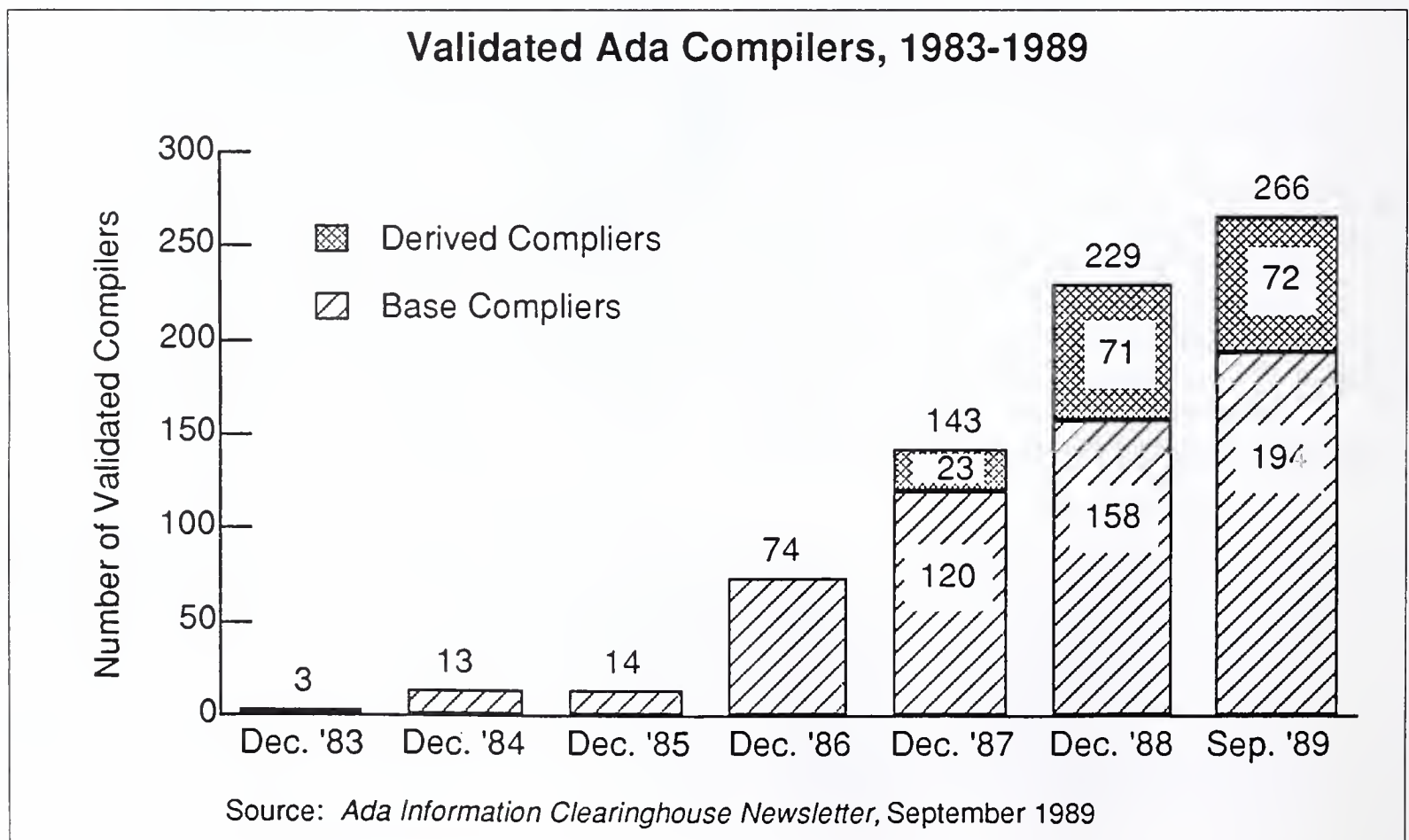
2. Policy Issues

In 1983, the DoD established Ada as the single, common computer language for mission-critical and aviation systems. Subsequently, DoD mandated Ada usage for both automated weapons and information systems. Dozens of vendors invested internal research and development dollars on Ada compilers and other Ada-related software products to meet the expected demand. It didn't happen.

In 1989, Ada projects still only accounted for a relatively small portion of the DoD market for information systems. In fact, some of the more interesting Ada projects, such as NASA's Technical and Management Information System (TMIS), are not even in DoD. Reluctance on the part of DoD program managers to use Ada has, in the past, limited the growth of this market.

Defense manages Ada activities through the Ada Joint Program Office (AJPO). Among other things, the AJPO markets the use of Ada throughout the DoD. This includes reversing the agency mindset that Ada is aimed primarily at mission-critical applications. The AJPO wants to broaden Ada appeal.

The Defense Advanced Research Project Agency (DARPA) is helping this effort along through a major initiative, the Software Technology for Adaptable Reliable Systems (STARS) program. Through STARS, DARPA is developing and making available a reusable library of Ada code, which will assist programmers in using Ada in some projects that appear appropriate.

It has been reported that most Ada software engineers and program managers believed that Ada had increased their productivity. However, in a recent report, GAO complained that DoD had not designed projects to assess the long-term cost savings and other benefits. This may account, in part, for Ada's slow progress, because budget constraints may inhibit program managers from experimenting with Ada.

In addition to the AJPO and the STARS program, Defense has a third initiative aimed at promulgating Ada. The Software Engineering Institute, run by contract at Carnegie-Mellon University in Pittsburgh, is helping to smooth the transition from all new software engineering technology, including Ada, into productive use. Exhibit III-16 presents funding information for the three organizations over three fiscal years. The funding growth, in spite of Defense budget cuts in other areas, suggests a strong and growing executive commitment to Ada.

EXHIBIT III-16

Ada Organization Funding, GFY 1986-1988

Ada Organization	$Millions		
	1986	1987	1988
Ada Joint Program Office	6.9	6.7	15.7
STARS Office	27.0	24.4	24.6
Software Engineering Institute	8.9	15.2	18.9
Total	42.8	46.3	59.2

3. Technical Issues

In examining the past and future growth of Ada in the federal government, it is worthwhile to consider some of the key technical issues. In some respects, many Ada products are now tied in with CASE products. Many vendors now offer product packages that include modules from both disciplines. Thus, vendors can offer more comprehensive solutions to agency problems. However, some agencies have been slow to take advantage of these packages because of cuts in training budgets.

In a recent report, the GAO identified five technical issues that have affected or will affect the growth of the federal Ada market. These are summarized in Exhibit III-17.

EXHIBIT III-17

Ada Technical Issues

- Availability of tools
- Compiler testing
- Real-time applications
- New real-time features
- Interface with DBMS

- Availability of Ada software development tools is increasing. Exhibit III-15 showed the growth in compilers. Other tools, including editors, debuggers, and configuration managers are now generally available. This explains in part why the Ada software products market will grow at a slower pace than the overall federal software products market.

- Better tests are being developed to determine compiler performance. While standards conformance is required, compilers need to be measured also in terms of the following:

  - Compile time efficiency
  - Object code efficiency
  - Compiler services
  - Embedded system requirements support
  - All of these directly affect the suitability of Ada compilers in supporting specific mission needs.

- Many agencies have not yet realized the benefits of Ada for critical real-time applications. In the past, Ada has not performed successfully in applications with severe timing and memory constraints. This problem arises from both the language itself and the compilers implementing the language.

- Some new Ada features will facilitate the use of Ada in real-time distributed systems. Specifically, improvements in Ada's tasking feature can be used to partition and program among various computers, particularly when they are sharing memory. Further, Ada's rendezvous mechanism, with some improvements, handles communications among computers.

- Full Ada benefits cannot be achieved without a uniform approach to using Ada with DBMS. No standard interface currently exists. Four methods have been proposed for a Structured Query Language (SQL) interface to Ada. However, some technical conflicts still need to be resolved.

4. Ada Applications

There are literally hundreds of applications either in development or production that use Ada. NASA's Technical and Management Information System (TMIS) mentioned earlier, is an example of a major nondefense initiative using Ada. The FAA systems modernization is another example. TMIS will provide the necessary collection, dissemination, and processing of data to manage the Space Station Program.

As might be expected, most Ada programs are in the Defense Department. They range from the very large, such as the Army Advanced Field Artillery Tactical Data System, with 1.5 million lines of Ada code, to the

very small, such as a modified fire control system for the M60 tank, with 3,100 lines of Ada code. The Navy will need 2 million lines of Ada code, along with another million lines of non-Ada code, for its Sea Wolf submarine combat system.

Despite its real-time problems, Ada is being used by the Air Force for a real-time aircrew training system. McDonnell Douglas is using Ada tools to develop a large-scale simulation system for aircrew training. Harris is providing the hardware, 40 of its Night Hawk real-time computers, on which the Ada programs will run. The Air Force intends to vary the processing power of the computers, depending on individual site requirements.

Historically, the Army has been more aggressive in fielding Ada systems, with the Air Force and Navy following in that order. However, the Air Force has shown new interest and commitment to Ada, so the orders of applications may shift in the Air Force's favor. With the exception of a few high-profile projects such as TMIS, civil agencies have shown little interest in Ada. However, with more compilers and tools available and with the inevitable shifting of personnel among agencies, Ada will probably become more popular on the civil side of the government.

IV
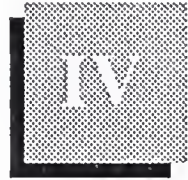
Federal Requirements and Trends

This chapter expands on the areas covered in chapter III and provides more detailed information on the directions that federal agencies are taking in software acquisitions and development.

Through an understanding of agency perceptions and attitudes, software vendors can structure their offerings in such a way as to appeal to the widest possible audience. Through an appreciation of the trends that are driving the federal market, software vendors can identify and implement steps that will maximize their penetration of the federal market.

A
Acquisition Type Selection

Agency respondents were asked their preferences on how they acquired software products. As shown in Exhibit IV-1, the majority of respondents preferred to purchase all categories of software products, rather than lease them from vendors. Only for systems control and applications software did a small percentage of respondents indicate that they will acquire these products through lease. The trend among federal agencies is to purchase software products rather than lease them from vendors as it was often the custom in the past. One of the 1988 changes that were added to the conditions underlying federal supply offerings requires vendors to offer permanent site licenses to government customers who lease products for 18 months. This change discourages agencies from leasing indefinitely and correspondingly reduces federal expenditures for software.

This in part reflects the trend for buying computer equipment rather than leasing it. It also reflects the relatively lower unit purchase price of many software products, helped along by competitive discounting in the federal market. Finally, it suggests greater agency adherence to OMB policies favoring purchase over lease.

EXHIBIT IV-1

Software Products—Purchase versus Lease

Software Products	Percent of Respondents	
	Purchase	Lease
Systems Control	87	13
Data Center Management	100	0
Data Base Systems	100	0
Program Development and Production Tools	100	0
Applications Software	96	4

B

Expected Changes in Product/Service Acquisition Mix

Overall, continuing budget constraints, as well as a greater variety of available packages are leading to an increase in the acquisition of packaged systems. More than half of the agency participants in this study indicated that they intended to acquire more packaged software, as opposed to custom software development, than they had anticipated previously (see Exhibit IV-2).

EXHIBIT IV-2

Agency Plans to Acquire More Packaged Software versus Custom Software

Acquiring More Packaged Software?	Percent of Respondents
Yes	58
No	38
Don't Know	4

Specifically, 73% of the agency respondents were expecting an average 29% increase in the number of packaged applications purchased by their programs or agencies. Almost 60% expected packaged systems software acquisitions to grow by one-third. None expected these acquisitions to decrease. Exhibit IV-3 details the projected changes in acquisitions by software products and services categories. Many respondents expect custom applications, custom systems software, and contract maintenance services acquisitions to experience no growth at their agencies. Few forecasted increases, and some actually predicted decreases in custom and contract maintenance acquisitions. Again, these findings are consistent with several overall federal trends.

EXHIBIT IV-3

Agency-Projected Changes in Software Products Acquisitions, GFY 1989-1994

Software Products	Acquisition Changes (Percent)*				
	Respondents Expecting Increase	Average Increase Expected	Respondents Expecting Decrease	Average Decrease Expected	Respondents Expecting No Change
Packaged Applications	73	29	-	-	27
Packaged Systems Software	57	33	-	-	43
Custom Applications	40	38	15	N/A	45
Custom Systems Software	22	23	17	33	61
Contract Software Maintenance	40	31	5	N/A	55

Note: N/A = Not Available

* Rows will not add to 100% due to rounding; note column headings

These findings do not vary greatly from those reported in an earlier edition of this report. Packaged applications and systems software were expected to increase, and custom developed software was expected to remain at the then current levels. If budget pressures intensify, this trend will become even more pronounced.

Intended operating systems usage for various applications gives insight into expected hardware platforms as well as agencies' adherence to standards that facilitate portability and interoperability of applications. As shown in Exhibit IV-4, almost half of all the respondents' applications were expected to run under MS/DOS and for UNIX-type operating systems. This indicates that the major portion of agency applications are intended to operate in microcomputer and midsize system environments. Correspondingly, a decline in mainframe usage by federal agencies is also implied. This finding is not unexpected considering the current general trend by federal agencies toward distributed and end-user processing.

EXHIBIT IV-4

Agency Operating System Usage
GFY 1989-1994

Operating Systems	Average Percent of Applications to Run
MS DOS	46.9
UNIX Types	46.5
VMS	36.4
MVS	25.0
DOS/VSE	20.0
VM	10.3
OS/2	8.7

Federal agencies are not expecting significant penetration of OS/2 usage by 1994. The data interestingly show that only a very few respondents predicted that a small percentage of their agencies' applications are expected to run under OS/2, which will probably be limited primarily to programmers and power users. Agencies will be slower to accomplish the migration of their applications to a new operating system that requires new more powerful hardware and redevelopment of existing applications. Confronted by increasing budget limitations, it is doubtful that agencies will have the necessary funding to acquire new hardware, and to convert existing applications. This may be bad news for those firms, such as IBM and Microsoft, which are marketing these advanced products.

As one would expect, packaged systems software is most often acquired by federal agencies at the same time hardware purchases are made. Exhibit IV-5 shows the percentage of respondents' software purchases that are expected to be acquired along with hardware procurements. However, only two-fifths of this sample indicated they intended to purchase their packaged applications software in conjunction with a hardware buy.

EXHIBIT IV-5

Expected Software Purchases Linked to Hardware Buys

Software Products	Average Percent of Software Purchased with Hardware
Packaged Systems Software	75
Packaged Applications Software	37

Although the federal government is using many umbrella-type contracts to acquire standardized hardware and off-the-shelf software packages, competitive opportunities for vendors still exist. Agencies tend to purchase their applications software independently of hardware acquisitions, when specific applications, or requirements demand it. This is most common when a system is acquired for a particular purpose as opposed to general-purpose, multiple application systems.

The software industry has developed many new products in the past few years that promise increased productivity gains for programmers and facilitate end-user computing access to data bases. Agency respondents were asked to rate the overall necessity of using some of these products over the next few years. The products' average ratings are listed in Exhibit IV-6. In general, these ratings were quite low. The use of CASE technology received the highest rating by respondents, 3.0. CASE tools relieve some of the tedious tasks associated with programming, such as code generation and documentation. SQL-based products and 4GLs followed close behind. UNIX was only rated a 2.5, considering that respondents stated it will be used to run almost 50% of their applications. Current industry estimates project that 70 to 80% of all federal contracts

specify UNIX. Other INPUT surveys suggest a mixed record on UNIX, POSIX, and related systems. Apparently, the jury is still out on these issues.

EXHIBIT IV-6

Necessity Ratings of Specific Software Products to Agencies

Product	Average Rating*	Applications Examples
CASE Tools	3.0	Data base development Software development
SQL Products	2.8	Data base development
4GLs	2.8	Data base development Software development General purpose User support
UNIX	2.5	General purpose Scientific/engineering
AI/Expert Systems	2.1	Decision support Management systems Imaging
Ada Compilers	1.6	Software development Real-time processing

* Based on 1-5 scale: 5 = Extreme necessity; 1 = Not necessary at all

Ada compilers were rated the lowest, at 1.6, confirming that Ada use is still primarily confined to DoD agencies. Although the number and types of Ada projects have increased significantly over the past two years, Ada usage is still slow to gain widespread acceptance. Funding constraints and technical issues still remain unsolved and continue to prevent extensive penetration of software development efforts.

Based on the average scores for each product, it appears that overall agency respondents are not enthusiastically adopting new software products to aid their information systems requirements. Traditionally,

the federal government has been slower to embrace new technology as a by-product of the lengthy federal procurement process, budget constraints, and lack of in-house technical expertise. Still the low scores suggest some shortcomings in vendor marketing efforts.

C
Hardware Platforms

Respondents in this study were asked to indicate the types of software that will run on the three basic classes of hardware platforms at their agencies.

The data for systems software products presented in Exhibit IV-7 do not reveal any surprises. Systems control software must be used on mainframes, midsize, and microcomputer systems. The sample expected data center management software to be used primarily for mainframe operations and secondly for midsize systems. Data center management software is out of applicability associated with large data center operations that maintain mainframe and midsize systems. DBMS technology in its various forms will be used fairly consistently by respondents across all

EXHIBIT IV-7

Agency Hardware Platforms for Systems Software

Systems Software Type	Percent of Respondents Indicating Hardware Platform		
	Mainframe	Midsize	Micros
Systems Control	40	44	40
Data Center Management	40	32	4
Relational DBMS	44	44	40
Other Data Bases	24	24	36
Data Dictionaries	44	36	28
4GLs	40	52	32
Artificial Intelligence	24	36	52
CASE Tools	24	40	44
Ada Compilers	12	16	12
Other Development and Production Tools	28	36	80

Note: Rows do not add to 100% due to multiple responses

three computer platforms. Those products intended for microcomputer processing, such as CASE tools and artificial intelligence products, will be used more frequently by federal agencies on microcomputer class machines.

The responses given for applications software (see Exhibit IV-8) are similar to those given for systems software products. Applications that require central management (e.g., accounting, human resources) will be run more frequently on larger systems. Those applications primarily associated with end-user functions (e.g., word processing, graphics, and electronic mail) were more usually cited to run on small machines.

The results suggest that agencies will be employing a three-tier architecture to accomplish much of their information processing requirements. Agencies intend to run most software products across all three computer platforms.

EXHIBIT IV-8

Agency Hardware Platforms for Applications Software Products

Applications Software Type	Percent of Respondents Indicating Hardware Platform		
	Mainframe	Midsize	Micros
Accounting	40	25	25
Human Resources	32	25	20
Information Analysis	36	32	48
Logistics/Distribution	24	32	28
Word Processing	16	32	84
Graphics	20	40	88
Electronic Mail	28	48	60
Scientific/Engineering	32	40	44
Project Management	20	28	64
Management Systems	36	24	36
Electronic Publishing	12	24	64
Administration	28	32	44
Other Agency-Specific	24	24	40

Note: Rows do not add to 100% due to multiple responses

Responses summarized by agency type for systems and applications software products are presented in Exhibit IV-9 and IV-10. Some of the differences noted between DoD and civil respondent groups are:

- DoD agencies will tend to run more systems software (e.g., systems control, data center management, RDBMS, data dictionaries, and 4GLs) on mainframe systems than civil agencies.

- Twice as many civil agencies will utilize accounting software on mainframes versus DoD agencies. One-fourth of both respondent groups will also run accounting software on midsize and microcomputer systems.

- Electronic mail applications will be more concentrated on microcomputers for DoD respondents. Civil agencies will tend to run this application with about the same frequency on both midsize and micro systems.

- Civil agencies will use more electronic publishing applications overall, primarily on PC-based machines.

EXHIBIT IV-9

Agency Hardware Platforms for Systems Software Products—DoD versus Civil

Systems Software Type	Percent of Respondents Indicating Hardware Platform			
	Agency Type	Mainframe	Midsize	Micros
Systems Control	DoD	63	50	63
	Civil	29	41	29
Data Center Management	DoD	63	38	0
	Civil	29	29	6
Relational DBMS	DoD	63	50	50
	Civil	35	41	35
Other Data Bases	DoD	38	25	50
	Civil	18	24	29
Data Dictionaries	DoD	63	38	13
	Civil	35	35	29
4GLs	DoD	75	63	38
	Civil	29	47	29
Artificial Intelligence	DoD	25	38	63
	Civil	24	35	47
CASE Tools	DoD	38	63	63
	Civil	18	35	35
Ada Compilers	DoD	25	25	13
	Civil	6	12	12
Other Program Development and Production Tools	DoD	38	38	75
	Civil	24	35	82

Note: Rows do not add to 100% for each agency category and are based
on total samples for each agency category.

EXHIBIT IV-10

Agency Hardware Platforms for Applications Software Products—DoD versus Civil

Applications Software Type	Percent of Respondents Indicating Hardware Platform			
	Agency Type	Mainframe	Midsize	Micros
Accounting	DoD	25	25	25
	Civil	47	24	24
Human Resources	DoD	25	25	25
	Civil	41	24	18
Information Analysis	DoD	38	25	38
	Civil	35	35	53
Logistics/ Distribution	DoD	25	25	25
	Civil	24	35	29
Word Processing	DoD	13	13	88
	Civil	18	41	53
Graphics	DoD	13	38	88
	Civil	. 24	41	88
Electronic Mail	DoD	25	25	75
	Civil	29	59	53
Scientific/ Engineering	DoD	13	25	25
	Civil	41	47	53
Project Management	DoD	25	25	63
	Civil	18	29	65
Management Systems	DoD	25	13	38
	Civil	41	29	35
Electronic Publishing	DoD	25	13	38
	Civil	6	29	77
Administration	DoD	25	13	38
	Civil	29	41	47
Other Agency-Specific	DoD	50	38	75
	Civil	12	18	24

Note: Rows do not add to 100% for each agency category, and are based on total samples for each agency category

D

Selection Criteria

In an earlier INPUT survey, respondents showed consistency in the ratings given on selection criteria for applications software vendors. Ratings of important factors in the selection of applications software vendors did not vary significantly by applications package users versus the total sample, as shown in Exhibit IV-11. However, several observations are evident:

EXHIBIT IV-11

Packaged Software and Vendor Selection Criteria—Applications Software

Criterion	Average Respondent Group/Rating*	
	Applications Users Subset	Total Sample
Ease of Use	4.6	4.4
Product Commitment	4.6	4.4
Performance	4.4	4.3
Documentation	4.3	4.3
Training	4.9	4.1
Support Reputation	4.3	4.0
Service Quality	3.9	4.0
Software Features	4.3	4.0
Application Knowledge	4.0	3.9
Ease of Implementation	3.7	3.8
Product Price	3.6	3.3
Federal Experience	3.0	2.7

* 1 = Not Important; 5 = Very Important

Updated 1987

- Vendor training topped the applications users' group selection criteria, but was rated a little lower by all respondents. Vendors' training services are more critical to users of applications software.

GSR3

- Ratings for ease of use and product commitment by the applications group were stronger, although both groups placed these criteria at or near the top of the list.

- The extent of federal experience needed by vendors was given the lowest ratings by each group, with price only one level above. For applications package software buyers, the quality of the product and the positive image of the vendor superseded these issues.

Systems software users, as well as the total sample, essentially rated most criteria equally, as shown in Exhibit IV-12.

EXHIBIT IV-12

Packaged Software and Vendor Selection Criteria—Systems Software

Criterion	Average Respondent Group/Rating*	
	Applications Users Subset	Total Sample
Performance	4.5	4.5
Documentation	4.3	4.4
Product Commitment	4.5	4.4
Ease of Use	4.0	4.0
Support Reputation	4.0	3.9
Service Quality	4.1	3.9
Software Features	3.9	3.9
Application Knowledge	3.8	3.7
Training	3.9	3.7
Ease of Implementation	3.3	3.4
Product Price	3.1	3.0
Federal Experience	2.5	2.5

* 1 = Not Important; 5 = Very Important

Updated 1987

- Performance and product commitment were rated the highest.

- The ratings given for vendors' federal experience were again very low for both respondent groups. Few agencies rated it above 2 on a scale of 1 to 5, with 1 being the lowest and 5 the highest. Systems software vendors do not need prior federal experience in this market, although a positive support reputation of the vendor is more vital.

  By comparing civil to defense agency respondents, the relative importance of each criterion indicates some additional trends. The findings were developed in previous INPUT surveys.

- The vendors' support reputation and service quality appeared more important to civil agencies that do not have adequate in-house staffs to maintain applications and systems software on their own.

- Product commitment was rated as very important in particular by civil and defense agencies buying applications packages, but not by defense agencies buying systems software. Again, DoD agencies may be more able to rely on in-house capabilities to maintain products.

As shown in Exhibit IV-13, importance ratings for custom software vendor selection also indicated some variance between civil and defense agencies regarding vendor support. Although other ratings were similar, civil agencies placed greater importance on the vendor's reputation for support. Civil agencies also rated target hardware and installation experiences somewhat higher, reinforcing the perception that civil agencies depend more on vendors to deliver complete, fully operational solutions.

EXHIBIT IV-13

Vendor Selection Criteria—Custom Software

Criterion	Average Respondent Group/Rating*		
	Civil	Defense	Total Sample
Development Experience	4.2	4.6	4.4
Application Experience	4.2	4.3	4.3
Target Language Experience	4.1	4.4	4.3
Integration Experience	4.2	4.0	4.1
Training	4.0	3.9	4.0
Support Reputation	4.0	3.5	3.7
Target Hardware Experience	3.9	3.3	3.6
Installation Experience	3.6	2.8	3.2
Price	3.2	3.2	3.2
Federal Experience	3.1	2.5	2.8
Agency Experience	2.8	2.4	2.6

* 1 = Not Important; 5 = Very Important

Updated 1987

Software performance as a selection criterion will increasingly mean more than answering the question, "Does the product do what we need?" Key criteria now include the following:

- Limiting the number of different software packages for each application to support greater standardization and ease of data center support.

- Standardizing data exchange formats allows file/data portability between applications.

- Adopting defacto, industry-standard packages ensures availability of I/O device drivers and packaged training programs and documentation.

E

Agency Use of Ada

The current Ada language form is outlined in the Reference Manual for Ada Programming Language MIL-STD-1815A. This manual incorporates the latest modifications and advancements to Ada design. Planning efforts are underway by the Ada Joint Programming Office (AJPO) to revise the language. The deadline for suggestions from users and industry ended in October 1989. The Ada language is employed for large-scale and real-time systems as mandated by the DoD, intelligence agencies, and some civilian agencies. Ada is useful for increasing productivity and for the development and maintenance of applications using relational data bases.

As a standard, Ada is designed to minimize problems in connecting different hardware types and architectures. Although the Army and the Air Force have taken the lead in using Ada in their systems, the Navy has just announced it will be the language of choice for over 170 mission-critical systems.

The Department of Defense has increased its interest and efforts to promote the Ada programming language for data base applications through the government. Under DoD policy, Ada is required for all new large-scale initiatives unless the contractor can substantiate that the use of another approved high-order language can be more cost-effective over the life cycle of the system. An additional DoD directive released in March 1987 dictated policy use of Ada in weapons systems. Since 1987, the AJPO has significantly narrowed opportunities to receive waivers from using Ada.

The Army has been most supportive in promoting the use of Ada as a means of improving software development from a managerial and technological perspective. Major Army Ada projects to date include: the Maneuver Control System, the Standard Finance System, and the Advanced Field Artillery Technical Data System. The Army also anticipates awarding a contract in late 1990 to connect its All Source Analysis System (ASAS) using Ada.

Ada is currently estimated to be in use in over 300 federal projects. However, accurate data on Ada projects is limited. DoD's record keeping on Ada was found to be incomplete in a recent GAO study issued in March 1989. Recent Ada usage in programming by government agencies has been expanded to include C3, surveillance and reconnaissance, weapons and avionics systems. Exhibit IV-14 is a list of Army systems that use Ada.

EXHIBIT IV-14

Current Army Systems Using Ada Technology*

- Advanced Field Artillery Tactical Data System (AFATDS)
- Army Test Program Set Support Environment (ATSE)
- DCL Ada Implementation Program
- Distributed Computing Design System 3.5 (DCDS)
- Experimental Version 1988 (EV88)
- FLLr Mission Payload Subsystem (FMPS)
- Forward Looking Infrared Mission Payload Subsystem
- Forward Area Defense Command, Control and Intelligence Systems
- Hellfire Tactical Missile (AGM114)
- Howitzer Improvement Program (HIP) Auto Fire Control System (AFCS)
- M60A3 Modified Fire Control System (MFCS)
- Maneuver Control System (MCS) Program
- Mobile Automated Field Instrumentation System (MAFIS)
- Noncommunications Jammer 2000
- Regency Net
- Reusable Ada Packages for Information Systems Development
- Robotized Wire Harness Assembly System (RWHAS)
- Single Subscriber Terminal (SST) AN/UGC-144
- Special Operating Aircraft (SOA) Remote Terminal Unit (RTU)
- Standard Finance System Redesign (STANFINS-R)
- UH-1 FS Redevelopment
- UH-60 Command Instruments System Trainer
- UH-60A Composite Trainer
- U.S. Army Europe Tactical Command System (UTACCS)
- Vehicle Magnetic Signature Duplicator (VEMASID)
- Versa Module Eurocard (VME)

* Source: Ada Information Clearinghouse Newsletter, July 1989

Embedded systems and real-time applications are currently using Ada, and agencies are also migrating toward decision-support systems that use Ada. Support for Ada in non-mission-critical applications stems from the DoD directive released in 1987. The largest potential use for Ada is expected to be in the area of military communications programs throughout the DoD.

NASA will be the first civil agency to support Ada extensively. The software to be developed for NASA's space station project and SDI will use the Ada programming language. The FAA is developing its Advanced Automation System in Ada.

Agency unfamiliarity with Ada, the different type of technology it represents, and unresolved technical issues continue to impede wider federal acceptance. This lack of acceptance is a result of several factors:

• Agencies' shortage of trained personnel and experience staff—as more Ada expertise is developed there will be more awareness of Ada and its potential usefulness

• Lack of Ada-specific software development tools

• Compiler performance issues

• Suitability for rapid-transaction processing

• Usability in distributed systems that process data simultaneously

• A standard SQL interface has not been developed that will allow use with various DBMSs

Some DoD elements have ongoing initiatives to foster the use of Ada. For example, through a contract with the Air Force, GE has developed some CASE tools to improve the productivity of Ada software developers. This step is critical to wider Ada acceptance. As another example, the Software Engineering Institute (SEI), a DoD-funded research and development center at Carnegie Mellon University, has established an entire Ada-based software engineering program. This program includes the following projects:

• Ada Adoption Handbook Project
• Ada Embedded Systems Testbed Project
• Application of Reusable Software Components Project
• Dissemination of Ada Software Engineering Technology Project
• Evaluation of Environments Project
• Software for Reduced Instruction Set Computers Project
• Tools and Methodologies for Real-Time Systems Project

In addition, the SEI has recently begun the Ada artifact project, a search for a large-scale, delivered software system coded in Ada, to use as an educational vehicle.

From INPUT's interviews with agencies and vendors, there appears to be an attempt to maintain a cooperative effort between government and industry to develop and implement Ada technology into agency systems. Most major federal contractors are already qualified in Ada. In fact, heavy investments were made by vendors before the market really developed. Furthermore, the DoD is looking to industry to develop 4GLs for Ada that can be utilized for development and maintenance of applications exploiting relational data bases.

An earlier Pentagon study suggested that the DoD mandate to use Ada may have been premature. Ada was initially overpromised, and DoD agencies could not use it because of slow maturation of the language and its compilers. The Pentagon has been unwilling to fund the large upfront costs if defense programs and contractors are to invest in Ada training, compilers, and software tool acquisitions. The defense budget cuts related to the current budget deficit measures also have had a major impact on early widespread use of Ada. According to the AJPO, internal spending for Ada has dropped from $25.8 million in 1988 to $15.1 million in 1990, and is expected to drop to $12.8 in 1991 despite a rise in the number of developing and planned Ada projects within the DoD.

F
Software Technology Trends

The software trends that are impacting how agencies are accomplishing their information processing are listed in Exhibit IV-15 . Agency respondents cited relational data base management systems (RDBMSs) most frequently. The federal market is generally perceived as lagging behind the private sector in adopting new technology. Agencies are now embracing this more efficient data base structure for their information systems operations, although use of RDBMS technology is already widespread in the commercial sector. Agency demands for the integration of available information are driving this growth.

Software Trends Impacting Agency Information Processing

Trends	Rank*	
	Agencies	Vendors
RDBMS	1	-
Networks/Distributed Systems	2	3
AI	3	-
Standards	3	1
CASE Tools	5	2
Optical Technology	5	5

* Rank based on frequency of mention by respondents.

Although respondents were asked specifically to reference software trends that were impacting their agencies' information systems, their responses indicated it was not easy for them to distinguish software trends from other information technology trends. Networks/distributed systems was ranked as the second most important trend based on the frequency of mention by respondents. Distributed systems are expected to grow, by the year 2000, to allow access of multiple, geographically distributed data bases. Vendors also ranked this trend third, indicating an increasing presence of networking/distributed computing within federal agencies.

Artificial intelligence products and standard compliance were both mentioned with the same frequency by respondents. AI/expert systems are being utilized by a wide range of civil and defense agencies. Some estimates show that 17% of government agencies purchased this technology in 1988. Although usage currently is centered in more civil agencies, the DoD is striving to evaluate and implement this technology. DARPA has fostered research and studies, and the Army established the Artificial Intelligence Center (AIC).

CASE tools were ranked fifth, which is in sharp contrast to the high necessity rating given to this type of product earlier in this chapter. The low rank given by agencies is perhaps a consequence of the lack of significant breakthroughs made by CASE technology in designing,

coding, and maintenance of software products. Optical technology advances were also viewed by respondents as impacting agencies' software directions.

Caution should be exercised in evaluating the respondents' answers to this question. Most expressed some difficulty in answering this question, and prompting was often necessary. Often when respondents must be prompted, the interviewer's suggestions may influence the respondent and result in unreliable data.

1. Fourth-Generation Languages

Software products referred to as 4GLs are more accurately described as comprehensive software development tools that are intended to extend the power of third-generation architectures and technologies. Fourth-generation languages (4GLs) are an integral set of functions designed to assist end users with minimum technical knowledge in developing applications. Agencies have started to acquire 4GL packages as a means of offloading requests for ADP staff time.

The primary issues that are of initial and general concern to potential users of 4GLs are programmer productivity gains (both during the development phase and the maintenance cycle), performance and hardware resource considerations, and management issues. Within the government, however, serious consideration must also be given to the future impact of 4GLs from a conversion standpoint.

Agencies are finding that successful implementation of fourth-generation technology requires careful planning, administration, and management throughout the organization. Items such as policy and procedures, standards, data administration and security, etc. should be carefully established prior to implementation, and monitored and revised as necessary after implementation. There has been a shift in 4GL usage within the federal government from a few years ago. At present, agencies are taking more advantage of the productivity gains, and ease of use promised by this technology. 4GLs are being used for data base and software development purposes, in addition to providing general purpose computing, and support to users.

The National Institute of Standards and Technology (NIST) published a guide to selection of 4GLs, to go along with its 4GL Functional Model. Federal agencies are benefiting from some guidance in this arena. Many agencies are looking for cost-justification data, selection criteria, or comparison reports.

Other technical industry trends, however, may lead to a reduction in the use of 4GLs in the federal government. INPUT sees the growing popularity of Computer-Aided System Engineering (CASE) as a partial re-

placement for 4GLs. For example, an Arthur Andersen product, IN-STALL/1 was designed to replace a 4GL for applications development in the DB2/DBMS environment. In many cases, the close integration of CASE and DBMS products will obviate the need for 4GLs.

2. Artificial Intelligence

DoD is pursuing several development AI efforts, particularly in the intelligence sector. This sector needs to train analysts and incorporate new technologies that provide useful decision aids to improve productivity. Artificial intelligence is gaining in usage in tactical situations, automated planning, and support applications. Research is currently underway exploring its role in unmanned military vehicles. The DARPA Strategic Computing Program has employed AI in its Autonomous Land Vehicle (ALV), Pilot Associate, and Air/Land Battle Management (ALBM) projects. Furthermore, the armed services are each working on prototype projects primarily to assist with analysis and application of requirements. Many initial studies and projects have already been completed.

Large-scale information processing is the principle area of applications for AI in civilian agencies automating decision-support and case-processing functions. These systems are mainly end-user production-oriented, and are standalone expert systems. The Internal Revenue Service (IRS) has developed an expert system to assist in the processing and review of tax returns. The feasibility prototype was very successful, and the use of AI to automate the auditing process will provide consistency and high-quality results at a fraction of the cost of earlier methods. The Social Security Administration migrated its examination, processing, and approval of applications for benefits to an expert system. Exhibit IV-16 details several government agencies' artificial intelligence projects.

EXHIBIT IV-16

Federal Agency Artificial Intelligence Programs

	Securities and Exchange Commission (SEC) EDGAR Pilot program	Department of the Army Army Materiel Command Materiel Readiness Support Activity (MRSA)	Department of the Treasury Internal Revenue Service	Department of Commerce Bureau of Export Administration
Agency	Securities and Exchange Commission (SEC) EDGAR Pilot program	Department of the Army Army Materiel Command Materiel Readiness Support Activity (MRSA)	Department of the Treasury Internal Revenue Service	Department of Commerce Bureau of Export Administration
Function of AI/Expert System	Analyzes financial information from electronically received corporate SEC filings	LOGPARS supports logistic program functions prepasses product warranties, scheduling and tracking, support plans, and SOWs.	Automates auditing procedures to identify questionable tax returns	Commodity classification for export applications
Status	Operational phase awarded to BDM	Operational	Development	Development
Hardware/ Software	Symbolics LISP machine IntelliCorp's Kee Software Financial Statement Analyzer developed by Arthur Andersen and Co.	ARITY PROLOG Microsoft C IBM PC and compatibles	LISP AI Language Symbolics Workstation	LISP-based GOLDWORKS Compaq 286 microcomputer
Comments	Employs modular architecture to allow for ease of modifications Natural language processing techniques used to locate and extract information Reads the financial tables and footnotes in EDGAR's data base and presents results in the form of ratio calculations	Operational at MRSA locations Ensures standardization of procedures and document formats across numerous users Policy and budgetary requirements consistently interpreted	$ 1.5 million spent to date IRS anticipates generating between $70 million to $100 million in additional tax assessments, and diminishing auditor staff years by half	LAN environment Employs object-oriented programming for complex commodity classifications

Other similar, large-scale administrative activities in the federal government that apply knowledge and regulations/guidelines to specific processing areas are prime candidates for AI systems. These areas include licensing, forms processing, and coding and validation. Although standalone expert systems currently account for most of AI development, eventually artificial intelligence will serve to link diverse sources of information to agencies' mainstream data processing.

G
Impact of Standards and Certification

The standards that are important to federal agencies in developing strategies for software applications and achieving system portability are listed in Exhibit IV-17.

EXHIBIT IV-17

Planned Standards Compliance, GFY 1989-1994

Standards

Standard	Percent
GOSIP	58
POSIX	58
SQL	42
Ada	21
SNA	21
TCP/IP	21
FIPS	13
X.25	8
Others	4

Percent of Respondents*
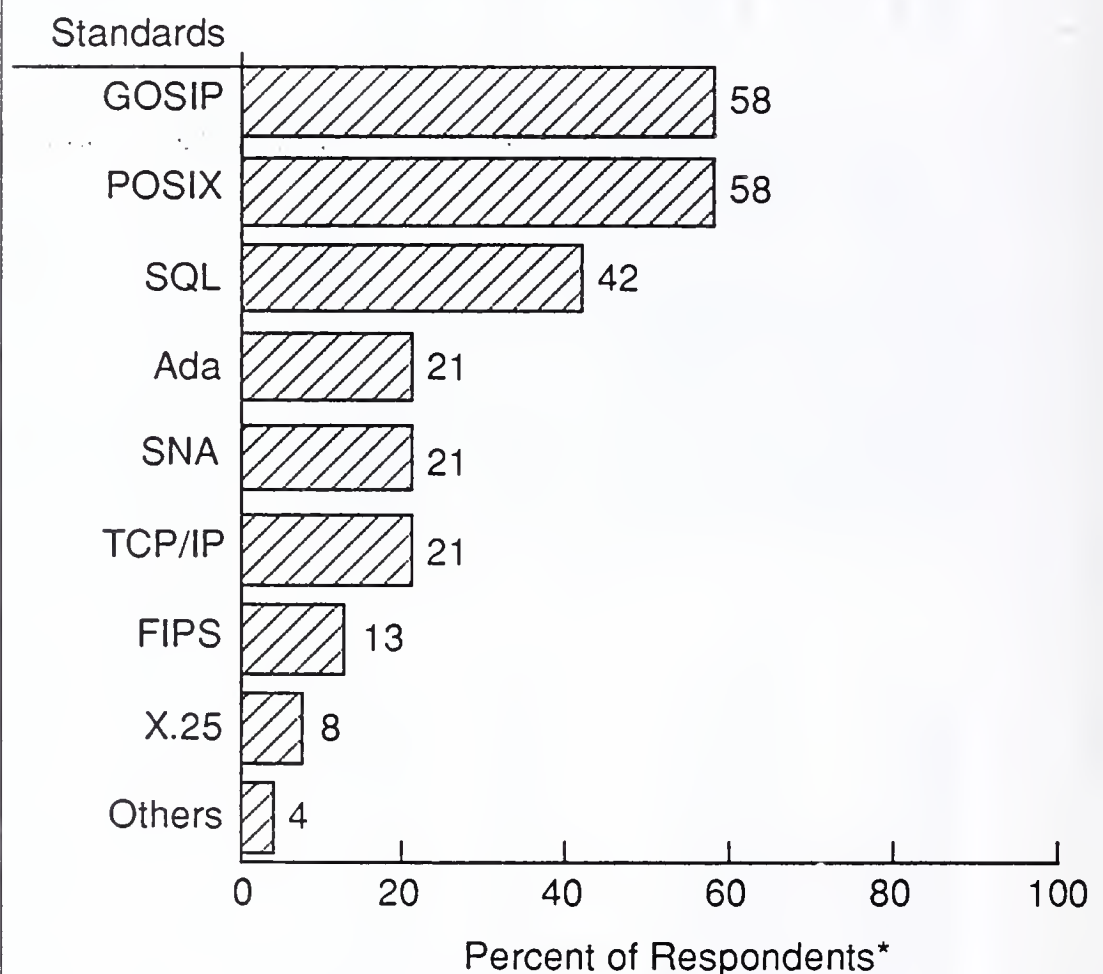
* Multiple responses were allowed.

Many of the accomplishments in formulating these standards are coming from the joint efforts of the NIST and industry. Recently standards activity in the government has focused on the adoption of an interim Federal Information Processing Standard for portable applications development based on the Institute for Electrical and Electronic Engineers' draft POSIX standard. NIST and industry representatives are close to finalizing specific details of the standard. Theoretically, POSIX is independent of any specific operating system; however, it is generally associated with UNIX systems. Agencies have released many RFPs for portable applications based on POSIX since its adoption in 1988.

OMB has mandated the use of OSI-compatible systems throughout the federal government. The issuance of a governmentwide policy for OSI will help to aggregate the market and establish consistency with commercial product development. The DoD issued a policy memorandum in which it stated a commitment to make the transition to OSI. A strong technical leadership position has been assumed by DoD. Defense agencies see the need to move to OSI to be more efficient in the future.

NIST estimates indicate that 70% to 80% of new-system acquisitions in the early 1990s will be OSI-compatible. NIST regards vendor supply as the major constraint on the growth of this federal market segment.

Almost 60% of the agency respondents indicated they would be complying with both GOSIP and POSIX over the next five years. The Government OSI Profile (GOSIP), a communications protocol, was also mandated as a standard in 1988 and will be replacing TCP/IP. GOSIP runs in parallel with the industry's OSI efforts for MAP/TOP application profiles and has as its foundation the protocols established by the International Standards Organization (ISO). However, many agencies are invested heavily in TCP/IP technology, which suggests its continued use for at least four more years.

NIST has just released two new application-layer specifications for version 2 of GOSIP that will allow greater flexibility to agencies using multiple networks and foster office document interchange across different systems. Version 2 also incorporates ISDN technology that allows connectivity to telecommunications networks.

One-fifth of the sample was still planning to adhere to the TCP/IP standard. Agencies are trying to accommodate the interconnectivity of applications among multiple hardware systems by adhering to GOSIP, POSIX, SQL, and Ada.

The use of SQL-based data base products permits the access of data across multiple data bases. Structured Query Language (SQL) is a relational data base language adopted by the American National Standards Institute (ANSI). SQL capabilities include defining, manipulating,

and controlling data in relational data bases. It is a simple, but powerful means to access and manipulate data. It was ratified as ANSI 186 by the ANSI Database Committee after receiving broad industry acceptance, and subsequently became a Federal Information Processing Standard. Most vendor relational data base products currently support SQL.

An SQL module is useful for applications development. It incorporates programmed interaction with relational data bases. The Army recently awarded a large contract for SQL-based data base management software in an effort to produce a high degree of interoperability with the Army's information architecture. SQL will also be used in personnel and logistics management systems.

Although not mentioned specifically by respondents, UNIX continues to gain popularity throughout the federal government as a solution to incompatibility between hardware environments. UNIX will remain of value as a software development system, particularly with supermini-computers and minisupercomputers. UNIX versions also have been customized to work on parallel computers. Other industry occurrences that impact the UNIX user community are developments in the X Windows graphics standard and the International Standards Organization networking standards. The extent to which AT&T can drive sales through its Air Force requirements contract, available government wide, will also affect the popularity of UNIX.

Government standards activities also are focusing on reduction of software risks. Standardization of government contractors' software development projects will be impacted by DoD Standard 2167—which directs defense system software development, testing, documentation, and evaluation of requirements—and by the Software Management Assurance Program, its NASA counterpart. These recommendations and standards are an attempt by the government to share risk. They are aimed at installing a specific set of procedures for contracts to promote development of high-quality, reliable software.

Agencies are becoming increasingly aware of the need to enforce existing standards and establish additional standards. This problem was reinforced in a recent study performed by the Air Force's Software Technology Support Center. The survey results indicated that one of the major problems facing the Air Force today was a lack of industry and DoD standards to support software and hardware environments.

Industry observations, as well as those of GAO, are that the promotion of development procedures is a lesser priority of DoD software program problems. The more significant issue is the development of more realistic requirements for software that are not bound by Mil Specs written in a vacuum.

The agency respondents in this study did not mention near-future adherence to Core Financial Systems Requirements standards promoted by the Joint Financial Management Improvement Program (JFMIP). GSA certifies software product compliance with core requirements that standardize key features across agency financial applications software. Although GSA certification is touted as mandatory for both existing financial applications and new systems, agency compliance is not currently enforced. Rather, OMB currently grants waivers because of the limited availability of certified software products.

At present, only two vendors' products have been approved for agency use: the Federal Financial System from AMS and the Federal Accounting and Reporting System from CDSI. Until this list is expanded, it is extremely doubtful that agencies will feel pressure to comply with JFMIP standards. Software vendors, however, need to ensure that their products support these standards in order to be successful in the federal financial software market in the long term.

Hardware vendors need to be concerned about available software for their platforms. Currently, the two approved packages run only on IBM platforms. However, Oracle has announced a product line that runs on multiple platforms, and expects it will be certified shortly.

H
Acquisition Methods

Regardless of whether software was acquired as a package or through custom development by a professional services firm, the methods of acquisition include competitive bids, GSA Federal Supply Schedules, or purchase orders.

As shown in Exhibit IV-18, differences exist in the frequency with which agencies acquire different types of software.

EXHIBIT IV-18

Agency Acquisition Methods for Software Products

Software Products	Average Percent by Acquisition Method*		
	Competitive Bid	GSA Schedule	Purchase Order
Packaged Systems Software	81	16	4
Packaged Applications Software	67	22	11
Custom Systems Software	70	3	8
Custom Applications	61	3	14
Contract Software Maintenance	58	16	6

*Rows will not add to 100% due to averaging and other acquisition methods.

- Competitive bids are more commonly used than other alternative acquisition methods for all types of software products. Defense agencies tend to make more frequent use of the competitive approach than do civil agencies. This observation is interesting in light of several recent reports on competition problems in defense agencies.

- Custom software will be acquired by purchase order only slightly more frequently than packaged software.

- GSA schedule orders and direct agency purchase orders, while used less frequently across the board, do provide opportunities for all types of software vendors.

I

Testing and Acceptance Procedures

The favorite testing and acceptance procedure varies for each category of software products and services, as shown in Exhibit IV-19. For both packaged systems and applications software, respondents indicated that they will use trial periods more frequently to evaluate new software. Agencies also will employ independent verification and validation

(IV&V) studies with the same frequency as trial periods to test packaged systems.

EXHIBIT IV-19

Agency Ranking of Testing and Acceptance Procedures Used for Software Products

Software Products	Average Rank* of Testing and Acceptance Procedures			
	Trial Period	Bench-mark	Parallel Testing	IV & V
Packaged Systems Software	1.4	1.7	2.8	1.4
Packaged Applications	1.4	1.8	2.4	2.7
Custom Systems Software	2.1	1.9	2.2	1.8
Custom Applications	2.2	1.8	2.0	1.8

☐ = Most likely used

* Rank based on likelihood of use.

Both custom systems software and custom applications will be evaluated more frequently using IV&V measures. Benchmarking also received the same ranking of use as IV&V for custom applications. In an earlier version of this report, the trial period was rated as the most common testing and acceptance procedure for all types of software products. It was generally considered the easiest, least costly process to implement. Agencies are beginning to shift away from using this method exclusively for all types of software. They are now trying to implement the testing procedures that are more appropriate for each software type.

Benchmarking was the second most frequent testing procedure named for three categories of software products. It is often costly but is sometimes the only appropriate testing procedure. A 1982 GAO study ("Bench-marking: Costly and Difficult, But Often Necessary When Buying Computer Equipment or Services," GAO/AFMD-83-5, 10/22/82, B-

208077 of 65 benchmarks indicated that the typical benchmark cost (external cost only) ranged between $40,000 to $200,000, but in GAO's opinion was the only appropriate test procedure. Much of the cost, however, usually stemmed from agency errors in benchmark programs, poor documentation, and difficulties in communicating with the agency in resolving technical issues caused by the first problem. GAO recommended that, when appropriate, other evaluation methods be used. In order of increasing cost, these methods include:

- "Paper" or technical evaluation
- Analytical modeling
- Simulation

INPUT reconfirmed this view with GSA. As of December 1987, there has been little change in benchmark policy. Agencies must, of course, be mindful of GAO's auditing standards in that some agency systems may be subject to GAO audit. These audits are specifically designed to assess the reliability and, therefore, the degree of risk involved in using computer-processed information. Various data reliability tests are performed by auditors on a timely basis to ensure the relevancy, accuracy, and completeness of computer output.

J

Follow-On Support

An important part of the vendor selection process is the vendor's reputation for supporting the client and the product. These perceptions have not changed since INPUT's earlier version of this report, and are included in Exhibit IV-20. With few exceptions, the ratings of all factors were high, indicating a high level of expectations for vendor support services. There was little variation in the ratings, but few differences were evident:

EXHIBIT IV-20

Ratings of Vendor Reputation
Factors In Postimplementation Support

Software Products								
	Average Ratings By Group*							
	Agency		Products			Acquisition		
Factor	Civil	De-fense	Appli-cation	System	Both	Pack-age	Custom	Total Sample
Fixing Errors	4.7	4.2	4.7	4.0	4.5	4.6	4.5	4.5
Improve Features/ Functions	4.1	3.9	4.4	3.3	4.0	4.1	4.5	4.0
Training	4.0	4.1	4.9	3.2	4.0	4.1	3.5	4.0
Extend Features/ Functions	3.8	3.8	4.1	3.2	3.8	3.8	4.0	3.8
Add Features/ Functions	3.8	3.8	4.3	3.3	3.8	3.9	4.0	3.8
Consulting	3.7	3.1	2.7	3.2	3.7	3.5	2.5	3.5

* 1 = Not Important; 5 = Very Important

Updated 1987

• Compared to defense agency respondents, civil respondents believed fixing errors and consulting services were slightly more important. Again, this belief reflects civil respondents' lack of in-house personnel to fulfill these functions.

- Applications software users rated all factors significantly higher than systems software users. This rating reflects the fact that systems software is more transparent to users than are applications. Training adds features/functions that are particularly important to applications users.

- Interestingly, training is not seen to be as critical for custom-developed software as for packaged software. Perhaps close association with professional services vendors over the development period provides some of the training that agencies would otherwise require.

- Consulting services provided by packaged software vendors are more important because the package buyer looks for advice in selecting a package. In custom development work, the associated consulting services (design, requirements definition) have usually been delivered prior to the actual development.

- Most respondents did not feel that vendors offered services beyond those previously listed, but some examples of additional services identified systems design/analysis, installation, programming, and data entry.

- When asked if vendors' problem resolution had proven to be "satisfactory," 77% of the respondents agreed that it was.

- Among those who said it was not satisfactory, the following suggestions for improvement were mentioned:

  - A more knowledgeable sales staff that shows interest, a suggestion (common in many other areas)

  - More-efficient contracting methods

  - More and better support

  - Faster service response

  - Postimplementation follow-through on commitments made at the time of sale

- Respondents were equally divided on the question of whether vendors could improve problem resolution performance. Cynics among the respondents felt poor performance was "just part of business" and a matter of "economics" for vendors.

Respondents in the current agency sample were asked what types of vendor support they intended to acquire through 1994. As shown in Exhibit IV-21, agencies intend to rely heavily on vendors for all types of

software support with the exception of modifying off-the-shelf applications. Although 60% stated that they will be seeking vendor assistance for this service, the data still suggest a strong reliance on outside programming assistance. Many agencies are still retaining the necessary in-house technical expertise to perform software applications modifications. INPUT believes that federal demand for contractor assistance for all types of programming services will grow as long as agencies continue to be constricted by inadequate pay scales and benefits that are not competitive with the private sector.

EXHIBIT IV-21

Vendor Software Support Intended by Agencies

Support Categories	Percent of Respondents
Install Release Updates	78
Install New Software	74
Modify Off-the-Shelf Applications Packages	57
Fix Errors	87
Modify Custom Applications	78
Software Training	100
Documentation	87
Others	13

V
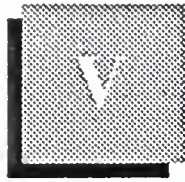
Competitive Trends

The preceding chapter provided a view of the federal government market for software and related services from the agencies' perspectives. In this chapter, the same market is examined by representative vendors' opinions and contrasted with the agencies to develop an understanding of the opportunities and concerns encompassing this market.

It is frequently useful to compare one's attitudes and perspectives of the federal market with those of competitors. This provides a sanity check on market strategies and may sometimes give vendors an advantage in competitive situations.

A
Vendor Participation

1. GSA Program Participation

GSA frequently acts as the intermediary between vendors and individual agency buyers through a series of programs designed to simplify the contracting process. GSA is responsible for the specification of approved products/services and the establishment of governmentwide prices for products/services. Schedule 70 of the Federal Supply Schedule (FSS) provides a program vehicle for agencies to acquire:

- Computer equipment purchases and rental
- Equipment maintenance repair and spare parts
- Software rental, purchase, and maintenance

The leading hardware vendors selling software products via FSS 70A in government fiscal year 1988 are listed in Exhibit V-1. Leading Schedule 70A independent software vendors are presented in Exhibit V-2. As noted throughout this report, systems software is frequently acquired with hardware from hardware manufacturers. This situation is reflected in Exhibit V-1, which credits hardware suppliers IBM, DEC, Wang, and Hewlett-Packard as being leading GSA Schedule 70A software products vendors.

EXHIBIT V-1

V-2

Leading GSA Schedule 70A Software Products Vendors—GFY 1988

GSR3

Vendor	Software ($ Millions)			
	Rental	Purchase	Mainte-nance	Total
IBM	158.3	-	-	158.3
Digital Equipment Corp.	-	-	29.8	29.8
Wang	-	5.8	5.9	11.7
Hewlett-Packard	-	4.7	4.4	9.1
Network Systems Corp.	1.6	0.4	-	2.0
Unisys (Sperry)	1.8	-	0.1	1.9
Unisys (SDC)	1.1	-	0.2	1.3
Prime	-	0.8	0.3	1.1
Data General	0.1	-	1.0	1.1

Source: GSA Information Resources, Management Services, Schedules Division

The companies on the leading independent software list show a shift in the types of vendors that are gaining market share from participation in the FSS from those listed in GFY 1987. Previously, many of the vendors were major systems software houses. Now project management, information management, artificial intelligence, and graphics vendors are appearing in the listing of the top 25 GSA Schedule 70A vendors. New technology and changing federal user needs are credited for the influx of these types of vendors on the FSS.

EXHIBIT V-2

Leading GSA Schedule 70A Independent Software Vendors—GFY 1988

Vendor	Software Rental, Purchase and Maintenance ($ Millions)
Relational Technology Inc.	5.1
Finalco, Inc.	5.1
Cullinet (Computer Associates)	4.5
CompuServe Data Technologies	3.0
Software AG of North America	2.7
Sun Microsystems Federal	2.4
IntelliCorp	2.2
ADR (Computer Associates)	1.9
Oracle	1.9
Softool Corp.	1.5
Precision Visuals	1.4
Symbolics	1.3
Metier Management Systems, Inc.	1.3
Information Dimensions	1.1
Syncsert, Inc.	1.0
AGS Management Systems	1.0

Source: GSA, Information Resources Management Services, Schedules Division

Exhibits V-3 and V-4 present additional information on software providers under two major GSA contractual programs.

The Contract Services Program (CSP) provides for the acquisition of professional services, primarily software development, to support the

ADP requirements of each GSA zone. Individual task contracts have been awarded for up to $1 million, but contracts of between $100,000 to $500,000 are more typical. Contracts are awarded for a one-year base period, with two or three possible one-year option add-ons. A total of $206 million was awarded through CSP during fiscal year 1988, and $186 million in GFY 1989. The downturn in 1989 occurred uniformly across all GSA zones and is attributed to federal budget constraints.

Current contractors under this program are listed in Exhibit V-3. GSA has just reorganized the CSP program to cover five zones instead of the previous eleven regions.

EXHIBIT V-3

GSA Contract Services Program (CSP) 1989

Current Awards	Zones
Advanced Management Inc. (AMI)	Eastern
American Management Systems	National Capitol
Applied Technology	Pacific
Computer Data Systems, Inc.	Eastern, Central, Western
DP Associates	Western
Key Data Systems	National Capitol
Martin Marietta	Pacific
OAO Corporation	Western
Penstar	Eastern Western
Planning Research Corporation	Pacific
Systems and Applied Sciences	Pacific Central

Systems software product contractors for the Programmers WorkBench (PWB) Program of the GSA Federal Software Management Support Center (FSMC) are listed in Exhibit V-4. In this program, GSA has distribution rights based upon a negotiated price for a period of one year with four one-year options.

EXHIBIT V-4

Federal Software Management Support Center Programmers' WorkBench Products

Category	Supplier
PWB/Base Configuration	Rand Information Systems, Inc.
Test Coverage Monitor	Aldon Computer Group
Translator	Computer Associates, Inc.
Data Name Standardization	Marble Computer, Inc.
Cross-Reference	Marble Computer, Inc.
Documentation & Metrics Analyzer	XA Systems Corporation
Source & File Compare	Sterling Software Corporation
Data Manipulation	XA Systems Corporation
Restructurer	XA Systems Corporation
Code Analyzer	VIASOFT, Inc.

Source: GSA Federal Software Management Support Center

Updated 1989

Although vendors are required to provide training and maintenance for one year, software problems are routed through GSA to Rand Information Systems (the chief architect of the workbench), and from there to the vendor. Programmers' WorkBench products, along with the related Analysts' WorkBench products enable programs to be developed more quickly and, from the programmers' viewpoint, more effectively. Although machine inefficiencies sometimes result, this has become less important as processor costs, on a productivity basis, have continued to decline.

2. General Market Participation

The federal government software market is serviced by a mixture of
vendors that provide diverse software products and services. Vendors
that participated in this study represent four general company types, as
shown in Exhibit V-5. Systems integrators made up the largest portion
of the sample, with systems software houses being the second-largest
group of respondents. Professional services firms and hardware manu-
facturers comprised nearly a third of the sample collectively.

EXHIBIT V-5

Sample Vendor Classifications

Company Types	Percent of Sample
Systems Integrator	40
Systems Software House	24
Professional Services Firm	16
Hardware Manufacturer	16
Other	4

The average percent of software revenue vendors earned in each software
category of products during 1988 is listed in Exhibit V-6. More than
60% of all respondents' revenue was generated from packaged systems
software sales. This corroborates the growing importance of packaged
software in the federal market. The next-highest revenue-generating
category of software products was custom applications, followed by
custom systems software development and packaged applications. Con-
tract maintenance services provided the smallest percentage of revenue
for vendors. This is somewhat surprising, in light of continued high
vendor spending for maintenance.

EXHIBIT V-6

Percent of Vendor Business in Federal Software Market—FY 1988

Software Products

- Packaged Systems Software — 36
- Packaged Applications — 12
- Custom Systems Software — 16
- Custom Applications — 20
- Contract Maintenance — 15

Average Percent of Software Revenue

(x-axis: 0, 20, 40, 60, 80, 100)
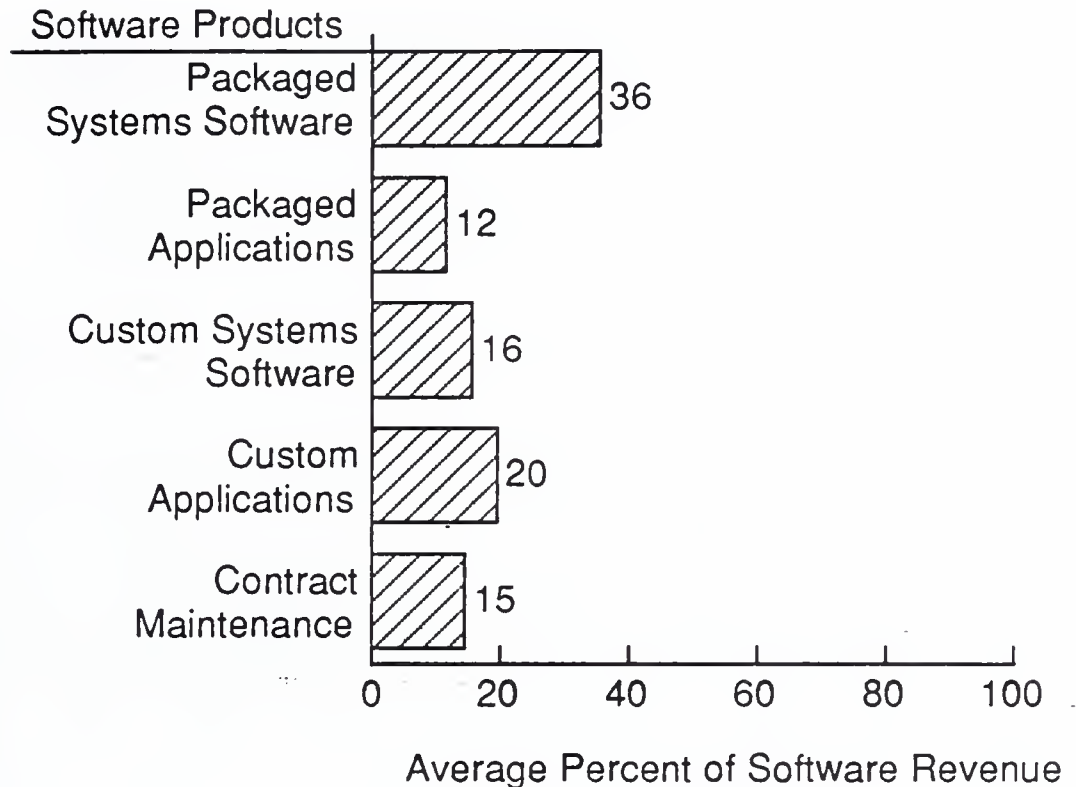
Note: On average, each respondent had 2.0 revenue-producing categories.

On average, each vendor company identified two categories of software products that are producing revenue from the federal market. Although the federal government is continuing to promote the purchase of packaged systems and applications packages, vendors continue to derive substantial income from custom software services. Unique agency missions drive requirements for custom developed applications that cannot be met using commercially oriented, off-the-shelf software.

The industry sample was also asked to specify the software produ ts and services their companies were currently providing, or planning to offer, to federal customers (see Exhibit V-7). Their responses differ substantially from some of the product categories that appear to be generating the least revenue. The data suggest that although custom software and contract maintenance services continue to be provided by more companies, these service offerings are the least lucrative for vendors.

EXHIBIT V-7

Software Products and Services Provided to Federal Agencies

Software Products

Packaged Systems Software	60
Packaged Applications	36
Custom Systems Software	60
Custom Applications	72
Contract Maintenance	92

Percent of Respondents
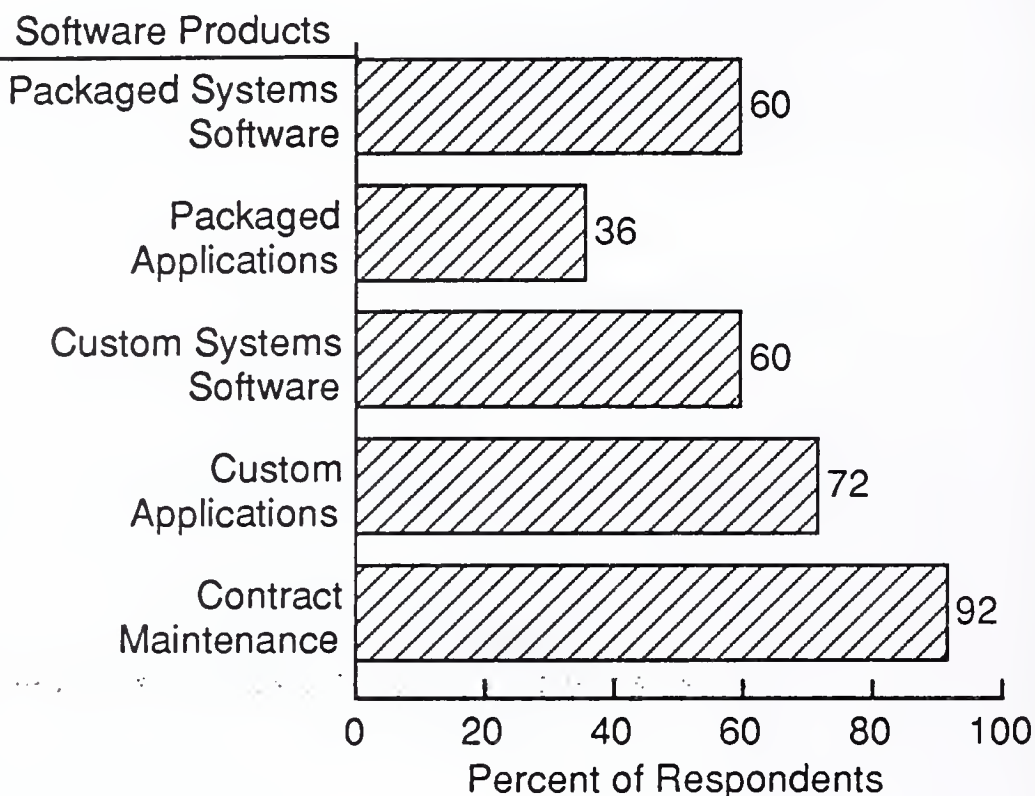
Note: 3.2 product categories were averaged per respondent.

Their responses appear to contradict the data present in the previous exhibit. For example, although vendors derive 15% of their contract maintenance business from the federal market, fully 95% of them provide this service. This fact suggests that although practically all vendors must provide this service to obtain federal business, it represents only a minor portion of their revenue stream.

Most vendors (72%) also provide custom applications software, even though the federal business accounts for one-fifth of their overall custom business. By contract, packaged systems software is provided by 60% of the respondents and the federal market presents 36% of the vendors overall business.

Vendors intend to provide a variety of software support services to agencies over the next five years, as shown in Exhibit V-8. Both agency and vendor respondents had similar expectations of the software support services they anticipated will be provided by vendors. The responses were normalized somewhat to facilitate comparisons.

V-8

EXHIBIT V-8

Expected Vendor Software Support to Federal Agencies

Support Categories	Percent of Respondents	
	Vendor	Agency
Install Release Updates	81	78
Install New Software	69	74
Modify Off-the-Shelf Applications Packages	58	57
Fix Errors	92	87
Modify Custom Applications	62	78
Software Training	100	100
Documentation	89	87
Other	40	13

The modification of off-the-shelf applications packages is the one area of support that will not be provided as frequently as other areas of support. As stated previously in Chapter IV, INPUT does not believe that vendor software support assistance will decrease. Support is expected to increase as agencies continue to demand more technical assistance from contractors.

Federal agencies face a diminishing qualified labor pool and are forced to seek contractor assistance for maintenance and development of information systems. It is interesting that both vendors and agencies rated software training at 100%. This reflects growth in end-user computing and the continued need for training of agency personnel.

3. Ada Vendors

Growing interest in the segment of the software and related services market requiring Ada dictates a closer look at the participating vendors. Exhibit V-9 lists major Ada compiler vendors ranked by the number of validated and derived Ada compilers each vendor offers. Although this listing does not relate directly to revenue realized from this segment, it does provide an indication of vendor commitment.

EXHIBIT V-9

Major Ada Compiler Vendors

Vendor	Number of Validated Compilers
ALSYS	45
TeleSoft	26
Verdix	18
DDC-I, Inc.	17
Meridan Software Systems	16
R.R. Software Inc.	9
Gould	8
Harris	8
Concurrent Computer	6
IBM	6
Motorola	6

Source: Ada Information Clearinghouse

Updated 9/89

The top three vendors expend most of their resources in the development, marketing, and sales of Ada products. For other vendors the effort is smaller, but growing. Altogether, there are approximately 50 organizations offering at least one validated Ada compiler. Almost 200 validated and 72 derived Ada compilers run on all computer platforms. Ada compilers are now seen in PC environments with the influx of 286- and 386- based micros. Compilers are available for DOS, UNIX, OS/2, and VAX/VMS operating systems.

The Ada Compiler Validation Capability (ACVC), an evaluation test suite, is used to award validation certificates for Ada compilers. The ACVC evaluation is based on the execution time for specific Ada constructs and measurements of compiler performance on programs that represent mission-critical applications. Certificates are now awarded for 18-month intervals. Compilers must be validated by the AJPO for use in DoD systems. The process consisting of over 3,000 tests only ensures

that the compiler's translation of Ada statements is in conformance with the language's current standards.

B
Vendor Market Perceptions

In the opinion of vendors interviewed by INPUT, the federal software and related services market will stay strong in the near term. Most vendors were typically optimistic that growth would occur in all areas of software products and services. This is consistent with INPUT's other findings. Exhibit V-10 indicates that vendor respondents forecasted that packaged applications software represents the fastest-growing segment. The vendors had similar views on the moderate growth rates for packaged systems software, custom systems software, and contract maintenance.

EXHIBIT V-10

Vendor Perceptions of Federal Software Products Acquisitions—GFY 1989-1994

Software Products	Acquisition Changes (Percent)*				
	Respondents Expecting Increase	Average Increase Expected	Respondents Expecting Decrease	Average Decrease Expected	Respondents Expecting No Change
Packaged Applications	100	55	0	-	0
Packaged Systems Software	57	13	21	N/A	21
Custom Applications	68	N/A	21	N/A	11
Custom Systems Software	44	16	44	35	13
Contract Software Maintenance	68	14	5	N/A	27

Note: N/A = Not Available

* Rows will not add to 100%; note column headings.

In contrast, agency respondents (see Exhibit IV-3) were more conservative in their prediction of how much the federal market for packaged applications will increase. However, agency respondents expected higher growth rates for packaged systems software, custom applications, custom

systems software, and contract maintenance than vendors. The same percentage of respondents in each group did expect packaged systems software to increase. This confirms INPUT's earlier prediction that federal systems software acquisitions were expected to increase in the early 1990s as the government continues to replace obsolete hardware and its associated necessary systems software.

Major agency/vendor differences reside in the areas of custom applications, custom systems software and contract maintenance. Approximately half of all agency respondents expected no change in the number of acquisitions for these services. A much smaller number of the vendor sample expected these services to remain stagnant.

Vendors predicted that increased federal requirements for packaged applications and packaged systems are the result of a combination of factors that are primary in driving increased acquisitions:

• The federal government's emphasis on purchasing "off-the-shelf" software, instead of custom software, to reduce costs.

• Standardization efforts that are underway to assure applications portability and interoperability.

Between 40% and 67% of all respondents believed that both DoD and civil agencies offered equal amounts of sales potential for all categories of software products and services (see Exhibit V-11). However, those vendors that did distinguish between the two types of agencies mentioned DoD agencies as possessing slightly more opportunities than civil agencies.

EXHIBIT V-11

Vendor Perceptions of Agency Opportunities for Software Products and Services

Software Products	Agency Opportunities Percent of Respondents*		
	DoD Only	Civil Only	Both
Packaged Systems Software	8	25	67
Packaged Applications	40	20	40
Custom Systems Software	33	25	42
Custom Applications	38	19	44
Contract Software Maintenance	19	14	67

* Rows may not add to 100% due to rounding.

Some civil agencies that offer the most opportunities for packaged systems software were intelligence/security agencies, NASA, Treasury, and FAA. The Department of Commerce was identified more strongly for packaged applications sales potential. For custom systems and custom applications, respondents indicated a wide range of civil agencies. Vendors saw contract maintenance opportunities at every type of civil agency, but Commerce, NASA, Treasury, the FAA, and intelligence agencies hold more promise for these services than others. Software product providers do not need to single out one or two agencies as target customers for products. Sales opportunities exist at a multitude of federal agencies for all classes of software products.

C
Vendor Selection Criteria

Agency and vendor respondents in a previous version of this report indicated only moderate agreement on the relative importance of criteria used by agencies in the selection of packaged applications vendors as shown in Exhibit V-12. Both groups agreed that the primary concern is "operation of the software." The factors "ease of use" and "performance" were also highly rated by both the respondent samples.

EXHIBIT V-12

Agency versus Vendor Ratings of Important Factors in the Selection of Packaged Software Vendors

Factor	Average Rating*	
	Agency	Vendor
Ease of Use	4.4	5.0
Product Commitment	4.4	4.0
Performance	4.3	5.0
Documentation	4.3	4.4
Training	4.1	4.5
Support Reputation	4.0	4.8
Service Quality	4.0	4.8
Software Features	4.0	4.2
Application Knowledge	3.9	4.6
Ease of Implementation	3.8	4.0
Product Price	3.3	4.4
Federal Experience	2.7	3.8

* 1 = Not Important; 5 = Very Important

Updated 1987

The characteristics directly related to software (i.e., documentation, features, ease of implementation, and price) also found general agreement among respondents, with two exceptions:

- Software documentation was rated higher by vendors than by agencies. This is surprising, given the frequent complaints agency clients express about the quality of software documentation.

- Software price received a higher rating by vendors than by agency representatives. It is reasonable that vendors are sensitive to the issue of price, particularly in dealing with the federal government. However, with the limited funds with which agencies have to work, and the nearly across-the-board mandate that outside services be purchased on a competitive basis (the next-to-last rating), agencies seemed to indicate that price is a "necessary," but not the absolute criterion for selection (an opinion that may not be shared by contracting officers).

The general area of support (training, support reputation, service quality, and commitment to the product) was perceived by vendors to be more important than it reportedly is to agencies.

- Only the criterion of training was rated by both sets of respondents as moderately important.

- Vendors rated service quality and support reputation among the highest agency criteria, but the agencies actually rated these factors as moderately important.

One difference between both respondent groups was the respective ratings of the importance of product commitment as a selection criterion. Vendors, with an apparently shorter view of product life, thought agencies would rate this criterion among the lowest. Agencies, ever mindful of the effort required to fund and then implement applications software, look to vendors to maintain the specific software in the vendor's active product line for some time. It is important that vendors have product expansion plans—including management teams, R&D budgets, and an understanding of changing requirements in place—and be able to articulate these to buyers.

Finally, respondents diverged on the importance of the vendor's level of applications experience as a criterion, but did agree that the vendor's federal experience mattered little. Applications experience was perceived by vendors to be very important to the agencies, while agency respondents actually rated this criterion considerably lower. Apparently, applications software vendors cherish their knowledge of the ability to develop software for specific applications, and are hopeful that agencies will hold these experiences in high regard as well.

Agencies, on the other hand, assume that any packaged applications software being considered will have the applications knowledge behind it, and further, that the proof is in the performance, not in the vendor.

As shown in Exhibit V-13, the ratings of agencies and vendors regarding agencies' selection criteria for packaged systems software were similar to those of packaged applications software, but with some notable exceptions. The specific factors of ease of implementation, and price were rated very high on the vendors' perception list and lower on the agency respondents' list.

EXHIBIT V-13

Agency versus Vendor Ratings of Important Factors in the Selection of Packaged Systems Software Vendors

Factor	Average Rating*	
	Agency	Vendor
Performance	4.5	4.6
Documentation	4.4	4.6
Product Commitment	4.4	3.6
Ease of Use	4.0	4.6
Service Quality	3.9	4.6
Software Features	3.9	4.2
Support Reputation	3.9	3.8
Application Knowledge	3.7	4.0
Training	3.7	4.0
Ease of Implementation	3.4	4.6
Product Price	3.0	4.2
Federal Experience	2.5	3.4

* 1 = Not Important; 5 = Very Important

Updated 1987

Agencies do not seem to make as much of an issue of implementation, either because they assume vendors will handle software installation, or because they assume their agency's staff would be capable of installing it. With the many stories about man-year efforts to install what was thought to be straightforward systems, vendors seemed to be accurate in holding the issue of implementation high on their list.

Differences exist in ratings for the remaining factors. Regarding price, it appears that vendors were more sensitive to the issue, but agencies believed their systems software needs outweighed the cost of meeting their information systems' objectives. In the category of support criteria, vendors perceived service quality and training as more important than agencies actually rated them, and product commitment as less important than it is. Vendors perceived their knowledge of the application as more important than agencies did.

The ratings of factors that influence vendor selection for custom software development are presented in Exhibit V-14. Agency and vendor respondents concurred that a vendor's development experience was the most important selection criterion. Both groups reported similar ratings for integration experience, placing it in the upper one-third of their list, and placed hardware experience in the lower one-third.

EXHIBIT V-14

Agency versus Vendor Ratings of Important Factors in the Selection of Custom Software Vendors

Factor	Average Rating*	
	Agency	Vendor
Development Experience	4.4	4.6
Application Experience	4.3	3.8
Target Language Experience	4.3	4.0
Integration Experience	4.1	4.1
Training	4.0	3.6
Support Reputation	3.7	4.3
Target Hardware Experience	3.6	3.9
Installation Experience	3.2	4.4
Price	3.2	4.3
Federal Experience	2.8	3.8
Agency	2.6	3.2

* 1 = Not Important; 5 = Very Important

Updated 1987

However, other criteria that can be categorized as "vendor capabilities" (development experience, application experience, target language experience, target hardware experience, installation, and integration experience) were nearly opposite. Agencies put more weight on the vendor's experience in specific applications areas and on the experience of the vendor with the target language. Vendors rated these two factors near the bottom of the capabilities group.

It seems that agency "buyers" are looking for specific capabilities that will ensure that the development effort in question may be effectively and efficiently done by the vendor. The vendors, on the other hand, hoped to "sell" their general installation experience instead. It seems only natural that vendors desire that their general capabilities be recognized. However, the ratings indicate that, to be most successful, vendors must also become thoroughly familiar with the specifics of a given opportunity and translate their general capabilities into the specifics of that opportunity.

Consistent with the above ratings, vendors also perceived that other factors would be more important to agencies than they actually appear to be, as follows:

- Price and support reputation were rated higher by vendors than by agencies.

- Similarly, training was given a high rating by agencies, reflecting their dependence on vendors in this area.

- Vendors were sensitive to competition based on price and the need for quality support, rather than some of the "vendor capabilities" listed above. Agencies were more concerned about the vendor's capability to do a specific job, regardless of the enhancements that the vendor may bring to the assignment.

- Both groups agreed that the vendor's federal experience and experience with a specific agency are among the least important criteria.

D
Trends

1. Changes in Specific Products

Vendors' projected changes for specific software products revenue are listed in Exhibit V-15. More than half of all respondents were currently offering or planning to offer artificial intelligence/expert systems, CASE tools, 4GLs, SQL-based products, and Ada programming services. Only 40% were offering Ada compilers to federal agencies. The responses suggest that many vendors in the federal software market are expanding their product lines to include the new trends in software technology. Overwhelmingly, all respondents forecasted increases in federal revenue derived from these products.

EXHIBIT V-15

Vendor-Projected Changes in Specific Software Products and Services Revenue

Software Products and Services	Revenue Changes (Percent)					
	Respondents Offering Products	Respondents Expecting Increase	Average Increase Expected	Respondents Expecting Decrease	Average Decrease Expected	Respondents Expecting No Change
AI/Expert Systems	60	93	57	7	N/A	0
CASE Tools	52	100	56	0	-	0
4GLs	52	92	134	0	-	8
SQL-Based Products	56	93	175	7	-	0
Ada Programming Services	64	93	46	0	-	7
Ada Compilers	38	89	77	11	N/A	0

Note: N/A = Not Available

The highest average revenue increases are anticipated for SQL-based products and fourth-generation languages, indicating a highly perceived market demand by federal agencies. Expectations were not as hopeful for artificial intelligence and CASE technology. The federal sector is known to be slower to accept newer advances in technology than the commercial sector.

Ada programming revenues were also expected to increase for vendors, but were given the lowest average percent increase. Those vendors that offer Ada compilers are anticipating reasonable increases in revenue from this product, although Ada has still not achieved widespread success and usage within the DoD.

Artificial intelligence is a market segment in which vendors are focusing on introducing new technology to the government primarily in the areas of software development and decision support. Currently, expert systems are being developed by agencies as standalone, end-user production systems automating knowledge-based processing.

Industry respondents identified current AI opportunities as being in product-oriented services for prototyping systems for federal agencies. Use of AI/expert systems is also especially effective in automating labor-intensive, repetitious tasks. As in other software areas, the government is looking to industry for solutions, not just products. Therefore, in response to this trend, AI vendors will migrate beyond standalone systems to new products that integrate approaches and solutions. AI will develop closer links to the main flow of an agency's information processing.

Many vendors, including IBM, are targeting the federal market AI/expert systems with new and expanded product offerings. AI feasibility has also been demonstrated when AI is employed to replicate decisions made by agency experts. Areas in which federal workers must interview the public using standard questions seem especially promising for AI. This is comparable to the commercial environment where, for example, insurance examiners use AI to help determine the acceptability of customers for life insurance.

2. Software Trends and Other Factors Impacting the Market

The new trends in software technology that vendors identified as impacting federal agency acquisitions are ranked in Exhibit V-16. It comes as no surprise that OSI and POSIX standards were mentioned most frequently by respondents. Vendors have been forced to realign their product offerings to comply with these new federal standards.

EXHIBIT V-16

Vendor Views of Software Trends Impacting Agency Information Processing

Trends	Rank*
Standards	1
CASE Tools	2
Network/Distributed Systems	3
Packaged Applications	3
Optical Technology	5

* Rank based on frequency of mention by respondents.

CASE technology was also perceived to be making a significant influx into the federal marketplace. This perception corresponds to the high average necessity rating that agency respondents placed on this technology for their respective organizations (see previous Exhibit IV-6).

Network/distributed systems and increased use of packaged software applications were ranked third by vendor respondents. The federal government's information systems modernization is partially driven by placement of the operation of tasks that previously were performed manually by end users and thus facilitating distributed processing of agency systems. Both OMB and GSA, in cost-cutting efforts, are encouraging agencies to purchase packaged applications as much as possible instead of investing in costly custom applications and to promote application portability among federal users.

The impact of optical technology was the fifth ranked trend mentioned by vendor respondents and also was equally ranked by agency interviewees. The perceptions of both respondent groups were compared previously in Exhibit IV-15. Agency respondents ranked RDBMS technology as having the most impact on their agencies' information processing, while vendors did not mention it at all. Vendors already accept relational data base technology as an established industry standard, not as a "new wave" technological trend in the software marketplace.

Other factors that industry respondents felt were affecting the federal software market are included in Exhibit V-17. The Competition in Contracting Act was seen as negatively impacting vendors. Its effect is to encourage agencies to use GSA Federal Supply Schedules to avoid lengthy procurement cycles that are often associated with open competitions. Multiple Letters Of Supply allowed on GSA schedules also decrease pricing and profit margins for those vendors that participate on the schedules.

EXHIBIT V-17

Vendor Views of Factors Affecting the
Federal Software Market

Factors	
• CICA	• Paperwork Reduction Act
• Procurement Cycle	• Gramm-Rudman-Hollings Act
• Contracts to Low Bidders	• Multiple Letters of Supply
• Source Code Ownership Issues	

The almost de facto practice of awarding federal contracts to the lowest bidders in competitive bid situations forces agencies and vendors alike to pay less attention to technical considerations that should be of utmost importance. The quality of services and products becomes limited when price is the major deciding factor for information systems.

Data rights ownership issues have recently raised serious concerns for vendors. Serious disputes exist between vendors of proprietary software and federal users regarding whether the government has the right to have access to or to own the source code for software products. Traditionally, vendors have held that source code nondisclosure is a proprietary right that protects their products' unique features. Agencies, on the other hand, faced with the increasing demise of many software vendors, are fearful they will not be able to maintain their systems if products are dropped or not maintained due to corporate acquisitions and mergers.

The Paperwork Reduction Act was viewed as having a positive effect on the software market for vendors. It has forced agencies to look to technology to alleviate federal workloads and opened up new opportunities for vendors servicing the federal market.

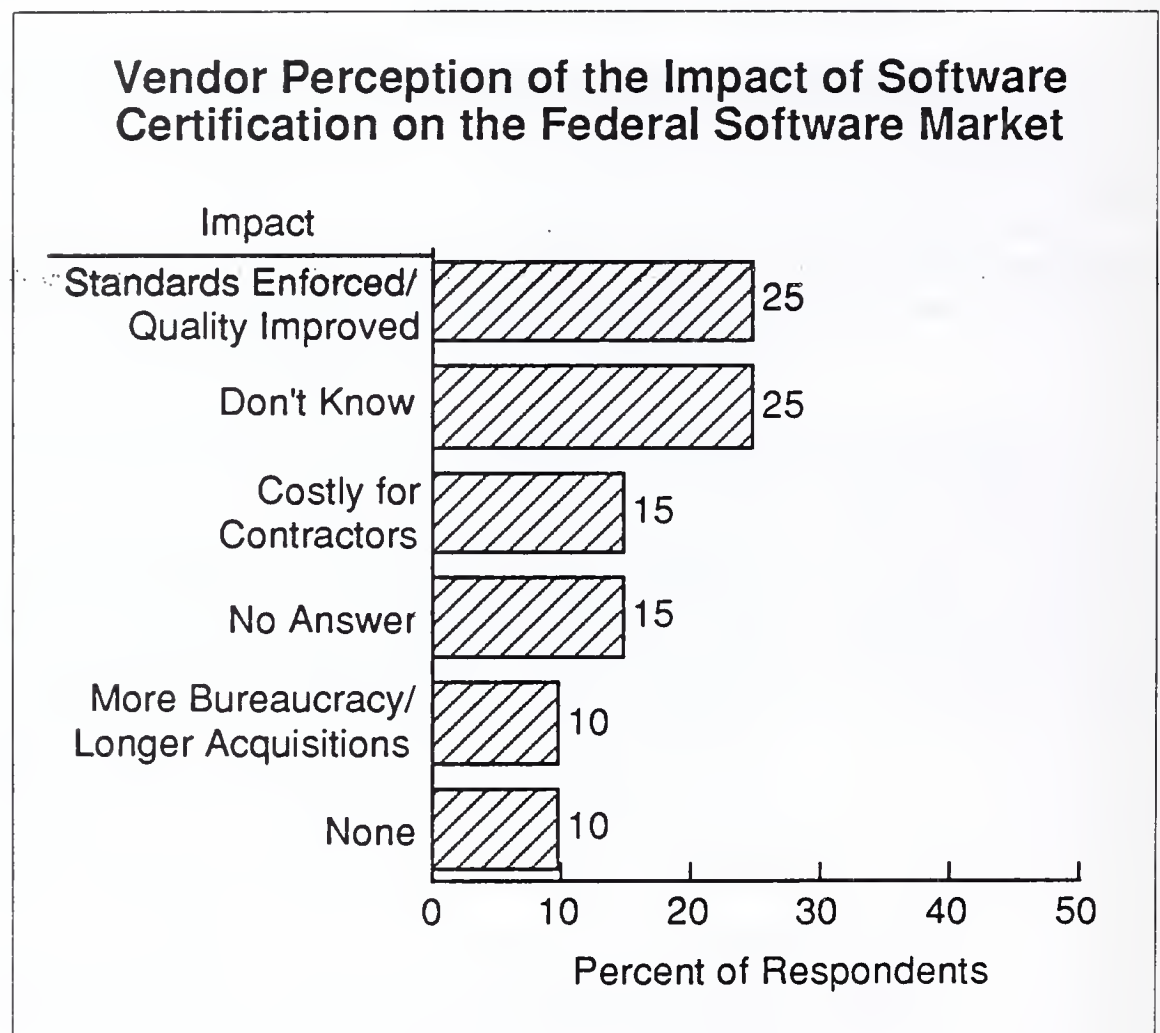The Gramm-Rudman-Hollings Act has severely hurt vendor opportunities, and will continue to tighten spending as long as the federal deficit remains a significant problem. Programs requiring new hardware and software have been cut and delayed, and this phenomenon will no doubt continue. Vendors participating in the federal market no longer anticipate large revenue increases as they did a few years ago and are scram-

bling to maintain market share. Many have already been forced out of business.

Vendor respondents were asked specifically what impact the software certification process was having on the federal market. Their responses are included in Exhibit V-18. Only 50% of the sample believed the certification process was affecting the market. The only positive impact that certification was believed to offer is that standards will be enforced, thereby improving the quality of software products provided to the federal government. Certification was viewed by 25% of the industry respondents as either increasing their costs, and correspondingly reducing their profit margins, or increasing the procurement process to allow time for certification.

EXHIBIT V-18

Vendor Perception of the Impact of Software Certification on the Federal Software Market

Impact

Impact	Percent
Standards Enforced/ Quality Improved	25
Don't Know	25
Costly for Contractors	15
No Answer	15
More Bureaucracy/ Longer Acquisitions	10
None	10

0   10   20   30   40   50

Percent of Respondents

E

Acquisition Methods and Test and Acceptance Procedures

In general, the vendors interviewed believed that software products were more frequently purchased by the federal government through competitive bidding (see Exhibit V-19). This is not entirely consistent with agency respondents' statements (as shown in Exhibit IV-18). Significantly more agencies indicated that they purchased both packaged sys-

tems and packaged applications software through competitive bids than what vendors believed. In addition, vendor respondents also noted more federal purchasing through GSA schedule vehicles and direct purchase orders than did agency interviewees. Comparison of the data between both groups suggests that vendors need to attune themselves more closely to the federal market's proclivities.

EXHIBIT V-19

Vendor Perception of Agency Acquisition Methods for Software Products

Software Products	Average Percent by Acquisition Method		
	Competitive Bid	GSA Schedule	Purchase Order
Packaged Systems Software	37	44	21
Packaged Applications Software	40	43	22
Custom Systems Software	74	16	24
Custom Applications	76	15	22
Contract Maintenance	61	31	22

Note: Rows do not add to 100% due to averaging.

Vendor respondents were also asked their opinion on which testing and acceptance procedures were most likely to be used by agencies for the various classes of software products. Their views, presented in Exhibit V-20, were similar to those of agency respondents (see Exhibit IV-19) for packaged systems software and packaged applications. Both groups of respondents concurred that trial periods were most commonly employed by agencies to evaluate these categories of new software products.

EXHIBIT V-20

Vendor Ranking of Agency Testing and Acceptance Procedures Used for Software Products

Software Products	Average Rank* of Testing and Acceptance Procedures			
	Trial Period	Bench-mark	Parallel Testing	IV & V
Packaged Systems Software	1.5	1.8	3.4	3.5
Packaged Applications Software	1.3	2.4	2.5	3.7
Custom Systems Software	2.8	1.8	2.8	2.6
Custom Applications	3.1	2.4	2.2	2.4

☐ = Most likely used

* Rank based on likelihood of use

Distinctions between the two groups of responses are present in the areas of custom systems software and custom applications. For the category of custom systems software, vendors ranked benchmark testing as the most frequently used procedure. Agencies ranked IV&V procedures first, and benchmarking a close second. Vendors thought parallel testing would be employed more frequently by agencies for custom applications, while agency respondents indicated more frequent use of benchmarks and IV&V procedures. The data also suggests that overall, vendors did not believe agencies were employing IV&V procedures as much as agency respondents reported.

Comparison of the data from this study to the previous study reveals a rise in use of trial period testing by government agencies for both classes of packaged software. This testing procedure places more risks on vendors that may be required to install and deinstall software without a promise of any tangible returns. It also places a higher premium on software reliability. Benchmark procedures continue to be frequently

employed to test all types of software, but agencies are increasingly utilizing IV&V and parallel testing measures for custom software requirements. INPUT assumes these changes are the combined result of increased pressure on government agencies to comply with new federal standards, as well as the necessity of using more sophisticated evaluation methods to evaluate more sophisticated software products.

F
Recommendations

Both groups of respondents in the earlier version of this report agreed on which vendor services were important postimplementation support aids. Exhibit V-21 shows that the ratings given by both groups were consistently favorable. To be responsive to agency needs, vendors, as well as agencies, need to recognize the quality of vendor support they receive.

EXHIBIT V-21

Agency versus Vendor Rating for Postimplementation Support Services

Services	Average Rating*	
	Agency	Vendor
Fixing Errors	4.5	4.5
Improve Features/Functions	4.0	3.8
Training	4.0	4.2
Extend Features/Functions	3.8	3.5
Add Features/Functions	3.8	3.9
Consulting	3.5	4.2

* Rating: 1 = Least Important; 5 = Very Important

Updated 1987

Some variations between the two groups did appear. Agencies appeared to value changes in product, more than training or consulting; vendors reversed the importance of these services. This phenomenon is entirely consistent with earlier INPUT analyses that indicated that vendors are inclined to support clients with service rather than with additional development.

G
Marketing Strategies

In this study, industry respondents rated the effectiveness of several factors that assist them in winning federal software contracts. The average ratings given by the sample are shown in Exhibit V-22. Vendors' integrated product lines and their teaming relationships with other vendors appear to influence winning federal contracts more than standards-oriented products do. This data is surprising, considering all the notoriety and pressure that is being aimed at vendors and agencies alike to conform to OSI standards.

EXHIBIT V-22

Vendor Rating of Factors that Assist in Winning Federal Contracts

Factors	Average Rating*
Integrated Product Line	4.1
Teaming Relationships	4.0
Bundling Products	3.7
OSI-Compatible Products	3.6
Third-Party Relationships	3.5
SAA-Compatible Products	2.7

* Rating: 1 = Not effective at all; 5 = Extremely effective

However, the ratings reflect the growing importance of teaming in practically all phases of the federal market. Teaming is especially important to software vendors for their approach to the GSA schedules market.

Vendors were also asked specifically what strategies were most successful for their respective companies in winning contracts. Their open-ended responses are listed in Exhibit V-23.

EXHIBIT V-23

Vendor Strategies Used in Competitive Federal Bids

Strategies	Percent of Respondents*
Creative Pricing	39
Teaming Relationships	38
Early Agency Marketing	26
Requirements Knowledge	22
Past Performance	13
Creative Technical Solutions	9
Don't Overdesign Solution	9

* Does not add to 100% due to multiple responses.

Creative pricing strategies received the most mentions by respondents, with teaming relationships a close second. Also, approximately one-fourth of the respondents specified that advanced marketing to an agency also plays an important role in determining the winning bidder. As INPUT has emphasized in other market analyses of the federal information systems market, the relationship of the vendor with the agency plays a crucial role in capturing federal contracts.

It is not surprising that more vendors indicated that pricing strategies were more effective than creative technical solutions, because of the government's general policy of awarding contracts to the lowest bidders. Athough lauded by most program managers as the most important crite-rion in evaluating bid proposals, in practice, the technical solution is not what contracting officers base contract awards on. Vendors are aware that the bottom line in winning federal contracts continues to be price and position their bids respectively.

Traditionally, bidding strategies for the software mode have been differ-ent than for other service modes for several reasons:

- A primary requirement is availability and commitment of key qualified managers and professionals.

- Use of fixed-price bids on late development and the implementation phases of new or replacement systems is increasing.

- Some specialized small businesses, consulting firms, and academic groups are key to an award if the agency believes that only specialized organizations have the requisite background or functional experience.

- In-depth support of the main body of employees and managers can be a key criterion.

- Reputation has high value in this service mode, especially for cost control, management commitment, staff quality, and availability.

In some bids, vendor knowledge of available and applicable software packages that can be fitted to agency requirements can be a deciding factor. A thorough knowledge of government contracting procedures, audit requirements, and bid evaluation processes is also essential to maximizing proposal scores for negotiated procurements. In-depth knowledge of, and exposure to, agency mission and system functional requirements are important elements for establishing credibility with the potential client.

Other key strategies that vendors employ in selling software products in the federal arena are not uniformly practiced by all of the successful contractors, but some combinations apply, as follows:

- Discounts for multiple sites within an agency have become a requirement.

- Discounts for multiple agencies within a cabinet-level department also apply.

- Beta testing of applicable products by key agencies permits placement on the Qualified Products List (QPL) for future accelerated acquisition.

- Qualification for the GSA Federal Supply Schedules (FSS) sometimes permits uncontested acquisition in small lots. The ground rules for an FSS annual agreement have some serious drawbacks, however:

  - The vendor must offer product/service discounts as large as those received by the vendor's "best customer," including foreign clients.

  - The vendor must offer a purchase plan or permanent license after a specified rental period.

  - The vendor must offer postinstallation service and support on a nearly universal basis.

- Demonstrated postimplementation support, especially of the Quick Reaction (QR) type.

- Availability of the package for several host machines, especially for agencies with a variety of CPUs.

- A continuing client education program to let agencies know the products' capabilities.

H
Issues and Concerns

Vendors in this study were asked to rate the impact of several industry and federal standards on the federal software market. The average ratings given each standard are presented in Exhibit V-24. Federal compliance with POSIX was rated as having the most impact on agencies' spending for software products and services. Adherence by agencies to the Government OSI Protocol (GOSIP), and to SQL-based products received the next highest ratings by industry respondents. Comparison of vendors' perceptions of standards impact at agencies and agency-planned standards compliance (see Exhibit IV-17) shows that both respondent groups had similar viewpoints on which standards currently have the most impact in the federal software market. Standards compliance in software products promote the portability of applications and avoid data redundancy among various hardware platforms.

EXHIBIT V-24

Vendor Rating of the Impact of Standards on Federal Software Acquisitions

Standard	Average Rating*
POSIX	4.0
GOSIP	3.6
SQL	3.5
Ada	2.9
SNA	2.5
SAA	2.5

* Rating based on a 1-5 scale; 5 = Extreme impact, and 1 = No impact at all

V-32
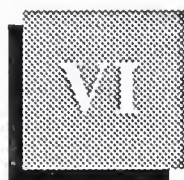
Key Opportunities

This chapter describes specific opportunities in the federal software and related services market. The opportunities list consists primarily of major programs that have software requirements and should not be interpreted as all inclusive. Virtually all federal information technology acquisitions do require software. INPUT's Procurement Analysis Reports (PARS) should be reviewed for additional opportunities.

The list of opportunities becomes shorter after fiscal year 1991 because new programs have not yet been identified or initially approved by the responsible agencies. Subsequent issues of this report and the INPUT Procurement Analysis Report will include additional programs and detailed program information for fiscal years 1991 through 1994.

A
Present and Future Programs

Funding for software and related services is provided in several budget categories of federal government agencies' A-11 budget submissions:

- Software and equipment as line items under capital investment do not include software bundled with hardware and software that is acquired on a lease basis.

- The programming and analysis line item includes some packaged software that will be purchased and customized and custom software maintenance after implementation.

- The operations and maintenance line item includes software mainte-nance as part of systems operations (facilities management) as well as independent contracts.

New information technology programs, including software and related services acquisitions that are larger than $1 to $2 million, are listed in at least one of the following federal government documents:

- OMB/GSA/NIST Five-Year Plan, which is developed from agency budget requests submitted in compliance with OMB Circular A-11

- Agency long-range information resource plans developed to meet the reporting requirements of the Paperwork Reduction Act of 1980 and as amended by the Reauthorization Act of 1986

- Agency annual operating budget requests submitted to both congressional oversight and appropriations committees based on the OMB A-11 information

- *Commerce Business Daily* notices of specific opportunities

- Five-Year Defense Plan, which is not publicly available, and the supporting documentation of the separate military departments and agencies

- Classified program documentation available to qualified DoD contractors

Software products and software development opportunities may or may not be specifically identified as such in these documents because of the following:

- Information technology planning documents usually identify mission requirements on functional performance objectives to be met by specific programs, rather than methods for meeting these requirements.

- Agencies have shown an increasing tendency to use integration contracts for implementation of larger, more complex systems. Software products and development requirements may be included in the prime contracts, rather than being met through separate acquisitions by the agencies.

All funding requests are based on cost data estimates of the year submitted, with applied inflation factors dictated by the administration as part of its fiscal policy and are subject to revision, reduction, or spread to future years in response to congressional directions. Some additional reductions will be likely in fiscal 1990 and beyond due to the deficit reduction constraints of the Gramm-Rudman-Hollings Act.

B

Software and Related Services Opportunities by Agency

Agency/Program	PAR Reference	RFP Estimated Schedule	Funding FY 1990-FY 1994 ($ Millions)
Air Force:			
AF Communications Command/ Program 6000	V-1-2	UNK	UNK
AF Data Systems Design Center/ Command Budget Automated System (CBAS)	V-1-21	UNK	UNK
Electronic Systems Division (ESD)/AF WWMCCS ADP Modernization (AFWAM)	V-1-27	UNK	175.7
AF Global Weather Central/ Advanced Computer Flight Plan (ACFP)	V-1-93	FY90	5.0
AF Logistics Command/ Contracting Data Management System-Phase II (CDMS)	V-1-104	3QFY90	52.8
Electronic Systems Division (ESD)/Special Operations Forces Planning and Rehearsal System (SOF-PARS)	V-1-105	1QFY91	UNK
Computer-Aided Acquisition Logistics Support (CALS)	V-1-108	UNK	UNK
USAF Headquarters/Enhanced Capability Assessment Module (ESCAM)	V-1-112	UNK	UNK
Electronic Systems Division (ESD)/Tactical AF Advanced Mission Planning System (TAFAMPS)	V-1-123	4/90	UNK

Agency/Program	PAR Reference	RFP Estimated Schedule	Funding FY 1990-FY 1994 ($ Millions)
Army:			
Army World Wide Military Command and Control System (WWMCCS) Information System (AWIS)	V-2-8	Various	UNK
Army National Guard/Reserve Component Automation System (RCAS)	V-2-34	1QFY90	181.9
Integrated Procurement System (IPS)	V-2-36	2QFY90	16.9
Office of the Assistant Secretary for Research, Development and Acquisition (RDA)/Acquisition Information Management (AIM) Program	V-2-39	1QFY90	UNK
CONUS Freight Management System	V-2-44	2QFY90	20.0
Installation Support Modules	V-2-45	2QFY90	UNK
Navy:			
Naval Data Automation Command (NAVDAC)/CAD/CAM II	V-3-14	Various	UNK
Fleet Numerical Oceanography Center (FLENUMOCEANCEN)/Primary Environment Processing System Upgrade/Replacement (PEPSU/PEPSR)	V-3-22	Various	UNK
FLENUMOCEANCEN/Primary Environment Processing System (PEPS) Software System (PSS)	V-3-46	Various	9.3
SPAWAR/Enhanced Naval Wargaming System Software Maintenance	V-3-66	FY92	UNK

Agency/Program	PAR Reference	RFP Estimated Schedule	Funding FY 1990-FY 1994 ($ Millions)
Space and Naval Warfare/ Navy World Wide Military Command and Control System (WWMCCS) ADP Modernization (NAVYWAM)	V-3-83	UNK	25.4
Naval Data Automation Command (NAVDAC)/Information Engineering II (IE-II)	V-3-104	2QFY90	100.0
Naval Data Automation Command (NAVDAC) Automated Billeting	V-3-106	1QFY90	UNK
Navy Comptroller Standard Systems Activity (NAVCOMPTSSA)/ Omnibus Support Services	V-3-109	1QFY90	UNK
Naval Accounting and Financial Center/Navy Standard Civilian Pay Systems (NAVSCIPS)	V-3-111	UNK	UNK
Navy Regional Data Automation Center (NARDAC)/Navy PC LAN Contract (AFCAC 299)	V-3-112	1QFY90	UNK
Space and Naval Warfare Command/Shipboard Tactical ADP Program (SNAP)	V-3-113	4QFY91	58.1
Marines:			
Marine Air Ground Task Force Lift Model II (MAGTF II) - Software Design and Development	V-3A-8	FY90	5.1
Department of Defense:			
DLA/Defense Automation Addressing System (DAAS) ADPE Replacement Program (DARP)	V-4A-4	Various	26.0
DLA/Computer-Aided Acquisition and Logistics Support (CALS)	V-4A-14	UNK	26.0

Agency/Program	PAR Reference	RFP Estimated Schedule	Funding FY 1990-FY 1994 ($ Millions)
DCAA Integrated Information System	V-4C-1	UNK	UNK
Defense Enrollment Eligibility Reporting System (DEERS)	V-4E-2	1QFY91	31.0
Assistant Secretary for Acquisition and Logistics/ Computer-Aided Acquisition and Logistics Support (CALS)	V-4E-4	Various	UNK
Defense Intelligence Agency/ Compartmented Mode Work-station	V-4H-1	UNK	75.0
DCA/Joint WWMCCS ADP Modernization (WAM)	V-4G-2	Various	UNK
Agriculture:			
Agriculture Research Service/ Laboratory/Office Automation	VI-5-22	Various	24.0
Food Safety and Inspection Service (FSIS)/Inspection Coverage System (ICS)	VI-5-26	FY90	UNK
Forest Service/Geographic Information System (GIS)	VI-5-30	1QFY90	113.0
Commerce:			
Census Bureau/Computer Replacement 2&3	VI-6-3	UNK	56.8
NTIS/Electronic Demand Printing	VI-6-20	UNK	UNK
National Weather Service/ Advanced Weather Inter-active Processing System for the 1990's (AWIPS-90)	VI-6-24	1QFY90	120.7

Agency/Program	PAR Reference	RFP Estimated Schedule	Funding FY 1990-FY 1994 ($ Millions)
Energy:			
Weapons Activity/CIM (Computer Integrated Manufacturing) System	VI-7-71	UNK	UNK
Oakridge Operations Office/ National Waste Information Network (NWIN)	VI-7-85	UNK	UNK
Office of Civilian Radioactive Waste Management (OCRWM)/Licensing Support System (LSS)	VI-7-87	1QFY90	UNK
Interior:			
USGS/Automated Graphics Digitizing Systems (AGDS)	VII-9-3	Various	UNK
BLM/ADP Modernization Project	VII-9-11	1QFY90 (Phase 1)	13.9
Office of Surface Mining Reclamation and Enforcement (OSMRE)/Coal Data Management Information System (CDMIS)	VII-9-12	UNK	23.8
EROS (Earth Resources Observation System) Data Center	VII-9-17	3QFY91	UNK
USGS/United States Geological Survey Mark II System	VII-9-19	FY90	110.5
Labor:			
ESA/Enhanced Federal Employees Compensation System (FECS)	VII-9A-4	UNK	40.3

Agency/Program	PAR Reference	RFP Estimated Schedule	Funding FY 1990-FY 1994 ($ Millions)
HUD:			
Computerized Homes Underwriting Management System (CHUMS)	VII-9B-1	3/90	2.3
State:			
Foreign Affairs Information System (FAIS) Recompetition	VII-9C-1	1990 (est.)	71.1
Justice:			
FBI/FOIMS (Field Office Information Management System)	VII-10-2	UNK	UNK
Antitrust Division/ Antitrust Office Automation	VII-10-17	Various	12.7
Automated Litigation Support (LSUP)	VII-10-20	2QFY92	48.5
Automated Litigation Support (ALS) Recompetition	VII-10-21	FY91	85.5
FBI/National Crime Information Center (NCIC) Upgrade	VII-10-24	UNK	145.2
Federal Prison Institute/ Unicore Standardized System-USS	VII-10-26	1QFY90	23.0
Transportation:			
Transportation Systems Center/ Multiple Contractor Resource Base	VII-11-31	UNK	UNK
USCG/Marine Safety Information System II (MSIS II)	VII-11-32	1QFY91	14.5

Agency/Program	PAR Reference	RFP Estimated Schedule	Funding FY 1990-FY 1994 ($ Millions)
USCG/Recruit Information Management System (RIMS)	VII-11-35	UNK	1.5
Treasury:			
IRS/Automated Examination System (AES)	VII-12-5	FY91	104.8
IRS/Tax Modernization Effort	VII-12-6	Various	296.3
IRS/Remittance Processing System (RPS) Replacement	VII-12-38	UNK	11.7
Bureau of Public Debt/ Data Administration	VII-12-54	UNK	3.1
IRS/Full Utilization of the Electronic Filing System (EFS)	VII-12-57	UNK	34.8
IRS/Servicewide Citator System	VII-12-62	UNK	77.9
IRS/Service Center Support Center	VII-12-65	7/90	UNK
IRS/Corporate Files on Line (CFOL)	VII-12-66	9/90	UNK
IRS/Document Processing System (DPS)	VII-12-67	9/90	UNK
Education:			
Office of Post-Secondary Education/Stafford/ Perkins Data Services	VII-13-8	FY92	54.2
General Services Administration:			
Multiple Award Schedule Program (MASP)	VIII-14-3	UNK	375.4

Agency/Program	PAR Reference	RFP Estimated Schedule	Funding FY 1990-FY 1994 ($ Millions)
GSA Systems (GSAS)	VIII-14-5	2QFY90	UNK
Contract Services Program (CSP)	VIII-14-10	Annually	1967.8
PBS Task Order Support	VIII-14-11	UNK	UNK
NASA:			
Headquarters/Space Station Freedom Program	VIII-15-61	UNK	UNK
GSFC/Customer Data and Operations System (CDOS)	VIII-15-62	FY91 (Phase CD)	UNK
KSC/Kennedy Inventory Management System (KIMS)	VIII-15-80	UNK	8.6
JSC/Operations Automatic Data Processing (OADP)	VIII-15-83	2QFY90	UNK
Department of Veteran's Affairs:			
Office of Information Systems and Telecommunications/ Financial Management Systems	VIII-16-8	UNK	UNK
Federal Emergency Management Agency:			
Integrated Emergency Management Information Systems (IEMIS)	VIII-18-7	FY90	7.3
U.S. Courts:			
Nationwide Data Network	VIII-30-1	UNK	UNK